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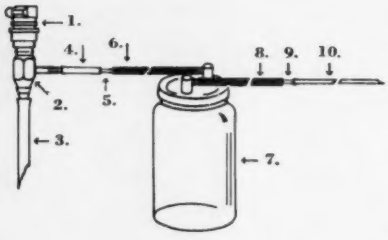

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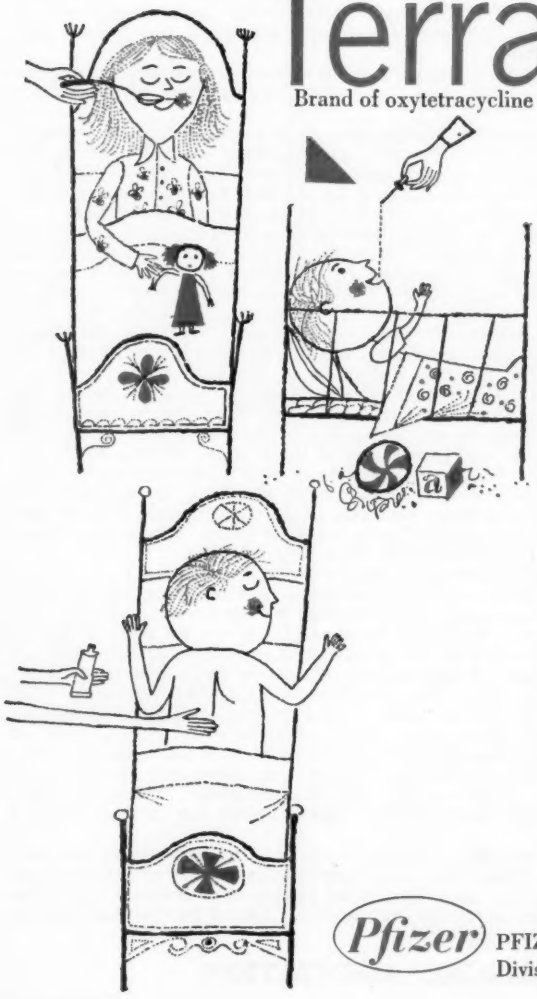

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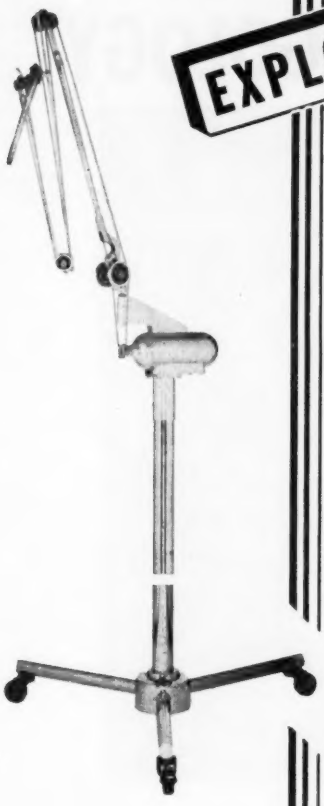

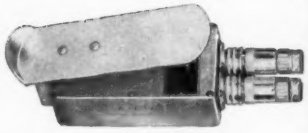

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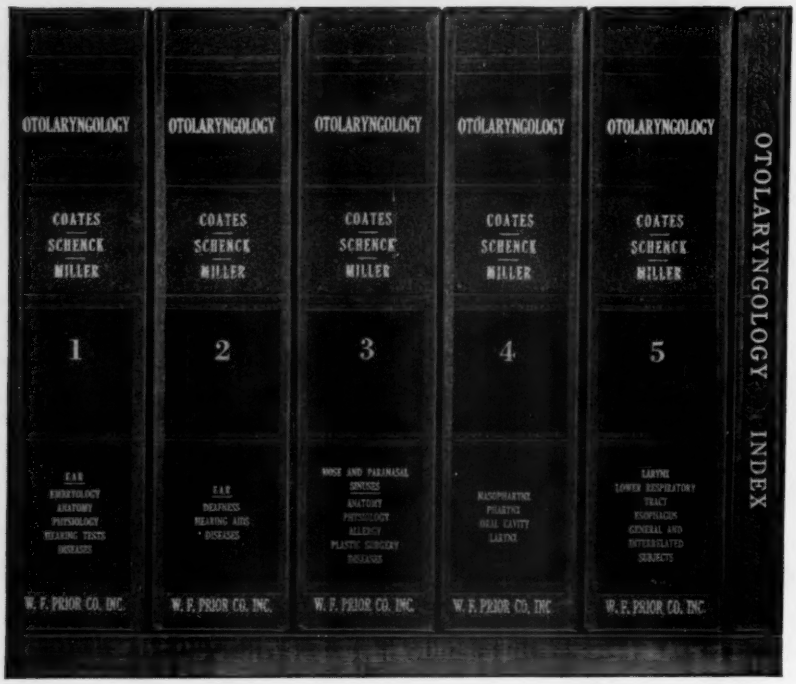

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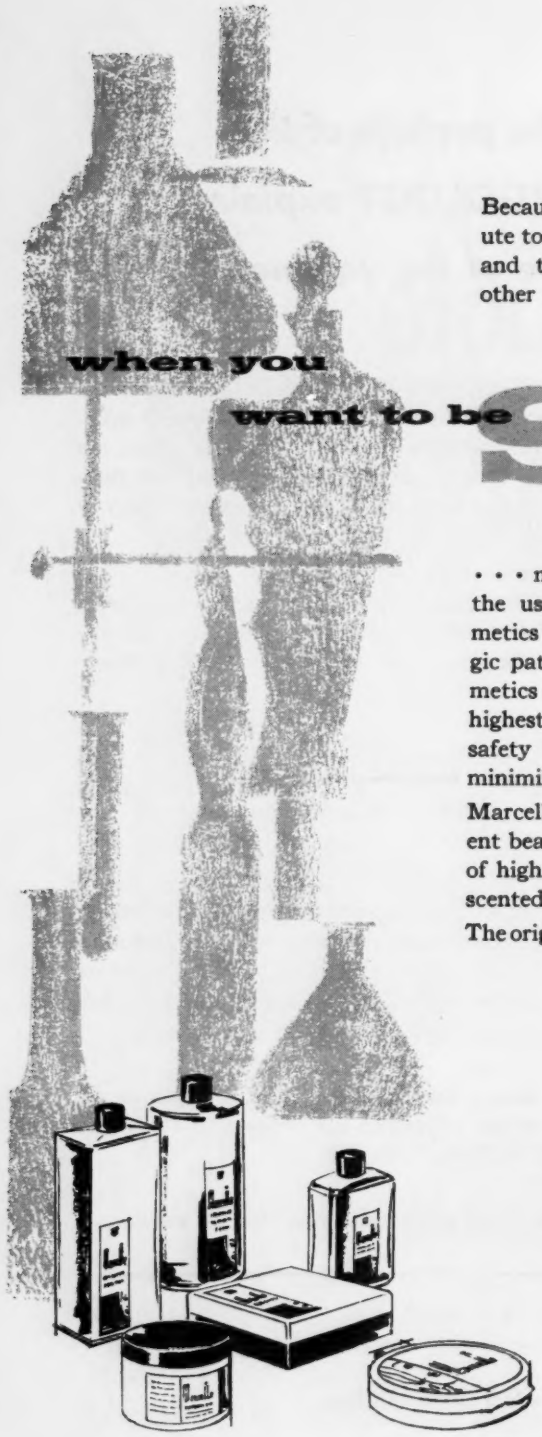

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The Role of the Cricothyroid Muscle in Tension of the Vocal Cords

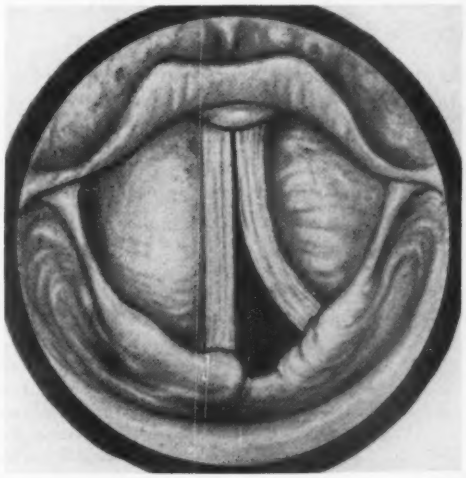
An Experimental Study in Dogs Designed to Release Tension of the Vocal Cords in Bilateral Recurrent Laryngeal Nerve Paralysis

LOUIS M. FREEDMAN, M.D., Boston

A study of bilateral recurrent laryngeal nerve paralysis in dogs was undertaken for the purpose of finding a way of altering the muscular control of the vocal cords so as to release either or both of them from the adducted position and so avoid the need for a permanent tracheotomy tube. Study of the muscular control of the larynx suggested that a more satisfactory solution of the problem than removal of the arytenoid and changing the position of a cord, as is done in the King, Kelly, and Woodman [1] operations, should be possible (Fig. 1).

Semon's Law * states that in bilateral laryngeal nerve paralysis adduction prevails longer than abduction because the posterior cricoarytenoid muscle, which controls the latter position, fails first. Murtagh and Campbell † lent support to this law by observing in animal experiments that the fibers of the adductor muscles were greater in size and number than those of the abductor muscles. General acceptance of this law led to the development of the King, Kelly, and Woodman operations. Clerf and Baltzell [6] questioned the validity of the law on the ground that the interarytenoid muscle is innervated by the external subdivision of the superior laryngeal as well as by the recurrent laryngeal nerve. But Lemere [7] showed that this branch of the superior laryngeal merely traverses the muscle to supply the underlying mucous membrane. Semon's observations were made largely in cases of injury to the nerves by tumors, aneurisms, and other conditions which produce gradual and vary-

Fig. 1.—Woodman removal of arytenoid cartilage and sewing back of the left vocal cord posteriorly.



Submitted for publication June 3, 1955.

From the Surgical Research Laboratories of the Beth Israel Hospital.

This paper was presented in substance before the New England Otolaryngological Society on Feb. 9, 1955.

* References 2 and 3.

† References 4 and 5.

ing degrees of imbalance in power between the abductor and adductor fibers. But the law does not explain the paramedian position of the cords under all possible conditions, especially after surgical division of the nerves.

During the years 1932-1934 I observed a number of recurrent laryngeal nerve paralyses following total thyroidectomy. These cases were done for the purpose of reducing the metabolic rate and lessening the work of the heart in chronic heart disease, in a study by Blumgart, Levine, and Berlin.[12] Most of

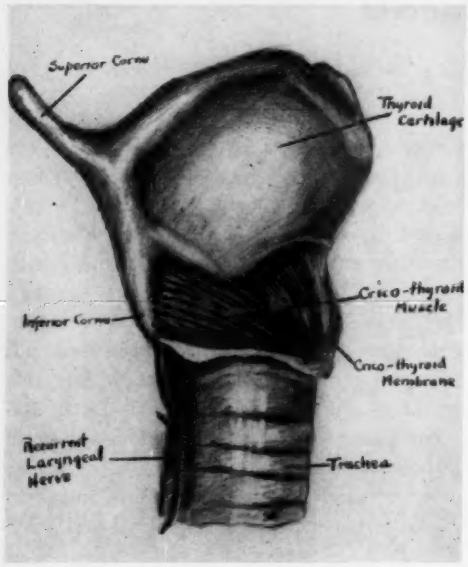


Fig. 2.—Anatomical drawing showing the cricothyroid muscle and the inferior cornu of the thyroid cartilage in relation to it.

these were unilateral and required no tracheotomy. The paramedian position of the vocal cords in all cases was striking. I quoted the Semon Law to my colleagues to explain this, even though it was not convincing to me, since, on severance of the nerve, paralysis of the abductor and adductor fibers should take place simultaneously. It was not a case of degeneration but of paralysis of both muscles in those instances in which the nerve was severed and not merely contused or otherwise injured.

In 1883 F. H. Hooper,[8] in "Experimental Researches on the Tension of the Vocal Bands," reported that the cricothyroid muscle was innervated by the external branch of the superior laryngeal nerve, fixed at the lower border of the thyroid cartilage, and attached to the upper border of the cricoid cartilage. In contraction he observed that this muscle pulled up the cricoid cartilage to tense the vocal cord. He also explained the importance of the blast of air from below and the use of the extrinsic muscles of the larynx in causing higher degrees of tension, enabling the singer to reach higher notes. This was the first instance in which serious attention was paid to any other factor than the recurrent laryngeal nerve in relation to the motility of the vocal cords.

Study of many postmortem cords suggested that the adduction in bilateral recurrent laryngeal nerve paralysis, in contrast to the relaxed position at death, must be accounted for on a different basis than Semon's Law (Fig. 2). Fixation of the inferior cornu of the thyroid cartilage to a facet type of small synovial joint to the lateral surface of the cricoid cartilage produces a pivoting action, which brings about tension and suspension of the cricoid. Woodman took this into account in his technique because he released this attachment in his operation. Consideration of all the factors concerned with opening, closing, and tensing the cords in order that speech and respiration may be carried out in a normal manner must take into account the nerve supply and the intrinsic function of the muscles of the larynx, which are as follows:

Muscle	Nerve	Action on Vocal Cord
Cricoarytenoid posterior	Recurrent laryngeal	Abduction
Cricoarytenoid lateralis	Recurrent laryngeal	Adduction
Cricothyroid	External branch of the superior laryngeal	Tension
Arytenoideus	External branch of the superior laryngeal	Tension
Thyroarytenoid	Recurrent laryngeal	Abduction
.....	Rest of the superior laryngeal	Sensory

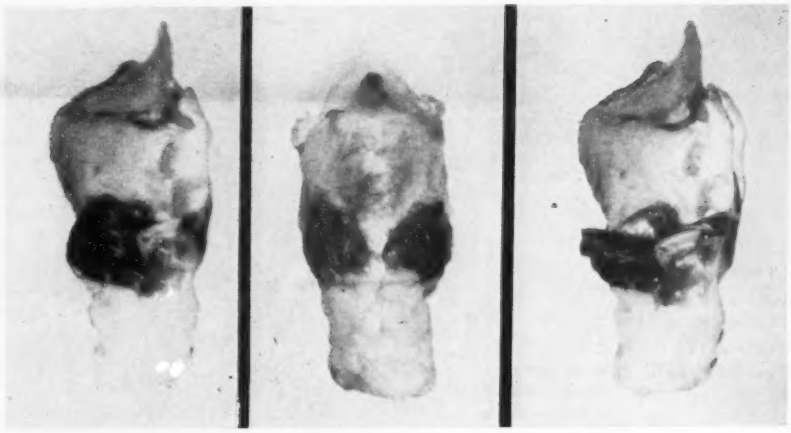


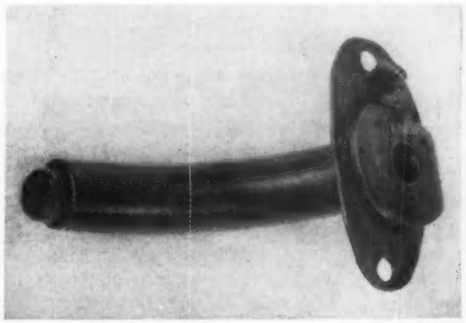
Fig. 3.—Cricothyroid muscle in relation to the thyroid cartilage, its severance from the inferior border of the thyroid cartilage, and severance of the inferior cornu of the thyroid cartilage at the same time.

Murtagh and Campbell and Terracol [9] demonstrated that the cricothyroid muscle, when tensed, is a very strong adductor muscle. Failure of the cords to assume the cadaveric position after severance of the recurrent laryngeal nerves therefore may be due to the action of the cricothyroid.

To test this hypothesis a study was undertaken in dogs, as follows: Both recurrent laryngeal nerves were severed and tracheotomy performed. After three weeks, during which the dog adjusted to the tracheotomy tube, the tissues had fully healed. The attachments of the cricothyroid muscles to the lower border of the thyroid cartilage all the way around to the inferior cornu (Fig. 3) were severed, and the attachments of the inferior cornua to the cricoid cartilages were severed. After two more weeks it was possible to remove the tracheotomy tube, because the breathing space between the cords was now (Fig. 4) adequate. Various incisions were tried. At first we made a vertical incision through which the pretracheal muscles could be severed and a tracheotomy performed. Eventually we found that a horizontal incision served more purposes and was as easy to handle as the vertical incision once the skin incision was made, since all the other tissues could be separated through it. We tried to see the effect of mere severance of the cricothyroid muscle and of the inferior cornua. We also tried the effect of severing only one recurrent laryngeal nerve and one side of the cricothyroid muscle from the thyroid cartilage and inferior cornu. Eventually we found that the horizontal incision and severance of the entire cricothyroid muscle and both inferior cornua, with tracheotomy, was the best combination.

During this study my attention was called to an article by N. D. Fischer [10] entitled "A Preliminary Report on the Application of the Motor Function of the Superior Laryngeal Nerve." In this paper Dr. Fischer suggested that the motor division of the superior laryngeal nerve in man has the same function as in the dog and stated that in the dog experiments in which he had cut both recurrent nerves and the right superior laryngeal

Fig. 4.—Tracheotomy tube especially constructed so that the inner tube is longer than the outer tube.



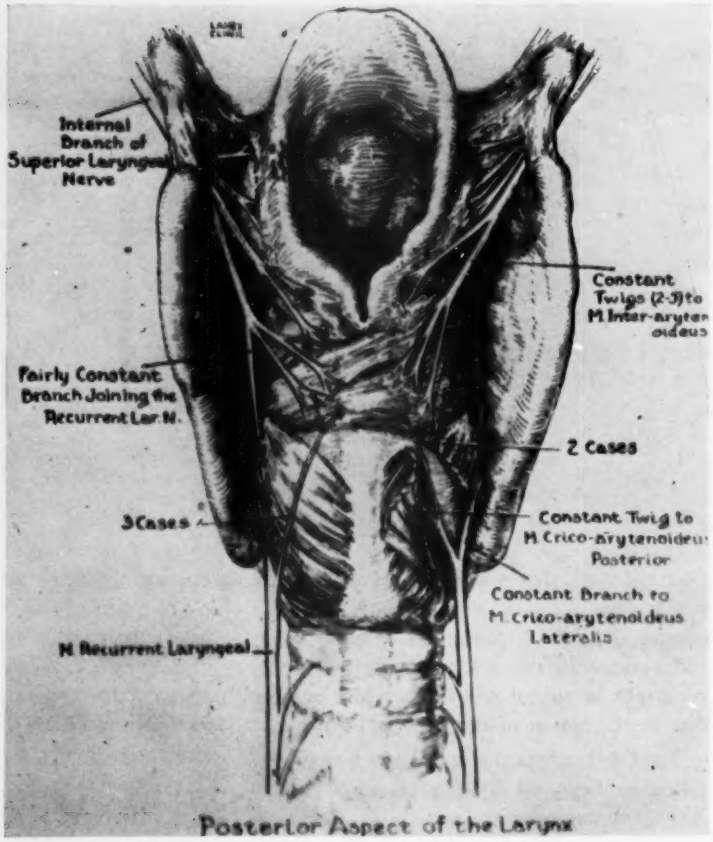

Internal Branch of Superior Laryngeal Nerve
Constant Twigs (2-3) to M. Inter-arytenoideus
Fairly Constant Branch Joining the Recurrent Lar. N.
2 Cases
3 Cases
Constant Twig to M. Crico-arytenoideus Posterior
Constant Branch to M. Crico-arytenoideus Lateralis
M. Recurrent Laryngeal
Posterior Aspect of the Larynx

Fig. 5.—The anastomosing of branches from the superior laryngeal with branches from the recurrent. (Reproduced with permission. Berlin, D., and Lahey, F. H.: Dissections of the Recurrent and Superior Laryngeal Nerves, Surg., Gynec. & Obst. **49**:102-104 [July] 1929.)

nerve the right vocal cord remained in the cadaveric position and so allowed for a good glottic chink. Since this procedure destroys laryngeal sensation, it is less desirable than the one I have described. Moreover, because of free anastomoses of the fibers of the superior laryngeal with other nerves, as shown in studies by Dilworth [11] and others, one cannot be certain that the release of tension will be achieved by merely severing the motor branch of the superior laryngeal (Fig. 5).

EXPERIMENT 1 (April 26, 1954).—Severance of the cricothyroid muscle from the inferior surface of the thyroid cartilage and of both inferior cornua of the thyroid cartilage.

May 4: Examination on this date showed a 4 to 5 mm. space between the cords, which did not adduct completely but did abduct widely. The recurrent laryngeal nerves were severed and a tracheotomy tube placed at the level of the second and third tracheal rings. Examination of the cords postoperatively showed them to be unable to abduct or to adduct completely, and a 5 mm. space between them (Fig. 6).

May 11: Examination of the cords showed a 6 mm. space between them. The tracheotomy tube was removed and the wound allowed to heal.

Under continued observation for several months there was no evidence of respiratory difficulty.

EXPERIMENT 2 (May 3, 1954).—The purpose of this experiment was to sever the recurrent laryngeal nerve and separate the cricothyroid muscle on the same side, and observe the cords, and in a second procedure later to do the same on the opposite side and, if necessary, at the same operation, to carry out tracheotomy. The left recurrent laryngeal nerve was severed, the left cricothyroid muscle separated from the inferior edge of the thyroid cartilage, and the inferior cornu removed from the thyroid cartilage and from its attachment to the left outer surface of the cricoid cartilage. Examination of the larynx postoperatively showed complete paralysis of the left cord, with the right cord overacting beyond the median line.

May 11: Examination of the larynx showed the same picture as when last seen. Under general anesthesia the right recurrent laryngeal nerve was severed and the right cricothyroid muscle was severed from the lower edge of the thyroid cartilage, and the inferior cornu removed. The dog was not tracheotomized because so much space was visualized between the cords postoperatively, that even though both cords were immobile, it seemed possible, if edema did not ensue, that tracheotomy could be dispensed with. Two days later the dog was found dead, and postmortem examination

Fig. 6 (Dog 1).—After the separation of the superior attachment of the cricothyroid muscle to the thyroid cartilage and severance of the inferior cornua of that cartilage from the cricoid lateral surfaces before bilateral recurrent laryngeal paralysis.

revealed edema of the false cords, even though the true cords apparently were free and apart. This made it evident that tracheotomy is always advisable until one is sure that no obstruction will follow.

EXPERIMENT 3 (June 7, 1954).—Under general anesthesia complete severance of the cricothyroid muscles from the inferior edge of the thyroid, removal of the inferior cornua of the thyroid cartilage, and severance of the right recurrent laryngeal nerve were carried out. The greater portion of cricothyroid muscles was removed to prevent readherence of the muscle to the thyroid cartilage. Postoperatively, the right cord was immobile but bowed away from the median line; the left cord was mobile but relaxed away from the median line.

June 17: The tracheotomy tube had become blocked by dry secretion and blood and had been forcibly extruded, but respiration was unimpeded because the tracheal opening was free. The dog seemed to be breathing freely through the larynx, also. The tube was reinserted.

June 24: Examination showed 5 mm. of space between the cords; respiration was free. The tracheotomy tube was removed and the wound allowed to close.

The dog was observed for two months and reacted normally, with no respiratory difficulty.

EXPERIMENT 4 (July 7, 1954).—Severance of the left recurrent laryngeal nerve and separation of the cricothyroid muscle on both sides, and removal of the inferior cornua without tracheotomy. Postoperative observation showed left recurrent laryngeal nerve paralysis and sufficient breathing space.

July 14: The right recurrent laryngeal nerve was severed. Both cords became immobile, but space between the cords was sufficient so that tracheotomy was not necessary, because enough time had elapsed between the first procedure and this one to allow for any edema to subside.

The dog was observed for several months, without any evidence of respiratory difficulty.

EXPERIMENT 5 (Aug. 3, 1954).—Both recurrent laryngeal nerves were severed; tracheotomy tube was placed. Laryngeal examination showed both cords to be motionless (Figs. 7*A*, *B*, and *C*).

Aug. 10: The cords were in close approximation. The cricothyroid muscles and the inferior cornua were severed; much of the cricothyroid muscles was removed to prevent reattachment. The tracheotomy tube was left in place, even though there was sufficient breathing space.

Aug. 17: No respiratory difficulty. At least 6 mm. of space between the cords. The tracheotomy tube was removed.

The dog was observed for several months and was free from respiratory difficulty.

EXPERIMENTS 6 (Aug. 23) and 7 (Sept. 23).—Similar to Experiment 5. Both dogs survived, were observed for some time, and were able to breathe freely without tracheotomy tubes.

EXPERIMENT 8 (Jan. 14, 1955).—Through a horizontal incision very much like the usual thyroid incision both recurrent laryngeal nerves were severed. The entire cricothyroid muscle was severed from the inferior border of the thyroid cartilage, and both inferior cornua were removed. Trache-

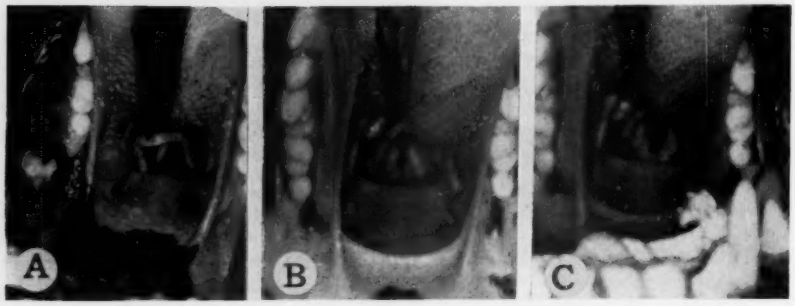


Fig. 7 (Dog 5).—*A*, Normal larynx with the cords open before operation. *B*, Cords closed following bilateral recurrent laryngeal paralysis. *C*, Cords open following severance of bilateral recurrent laryngeal nerves and severance of the cricothyroid muscle and inferior cornua.

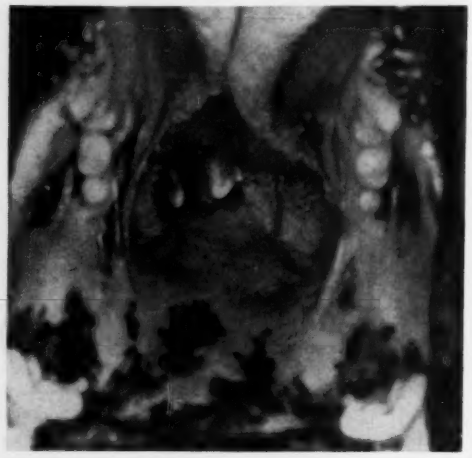
otomy was carried out and a tracheotomy tube inserted.

Jan. 25: The dog was breathing well. The cords were motionless, and there was sufficient space between them for respiration.

Feb. 1: The cords were quite widely open. The tracheotomy tube was removed. The dog was observed for more than three months and then discharged from observation with normal respiration.

EXPERIMENT 9 (Feb. 9, 1955).—This experiment was carried out for the purpose of noting whether there would be sufficient breathing space after bilateral severance of the recurrent nerves and removal of only one cricothyroid muscle and the corresponding inferior cornu. After bilateral severance of the recurrent nerves, the left half of the cricothyroid muscle was removed in its entirety, together with the inferior cornu on that side. Tracheotomy was performed (Fig. 8).

Fig. 8.—Severance of both recurrent laryngeal nerves and only the left half of the cricothyroid muscle severed from its thyroid cartilage attachment; also, severance of the inferior cornu on that same side.



Feb. 15: Both cords were immobile, with about 4 mm. of space between them.

Feb. 23: Tracheotomy tube was removed.

March 20: The dog has had no difficulty in breathing and was released from observation.

SUMMARY

On the principle that abduction, adduction, and tension are the three main factors concerned with the motility of the vocal cords and free respiration, a series of experiments was carried out on dogs to sever, first, both recurrent laryngeal nerves and thus ensure bilateral recurrent laryngeal paralysis. Tracheotomy was then carried out. Later, the cricothyroid muscles were detached from the lower border of the thyroid cartilage and the inferior cornua of the thyroid cartilage severed from their attachments to the lateral surfaces of the cricoid cartilage. When, by observation, it was evident that the glottic chink was wide enough for normal respiration, the tracheotomy tube was removed and the wound closed. The dogs were able to breathe freely without apparent discomfort thereafter. It is hoped that this method may be of use in human beings and make unnecessary more complex procedures involving removal or displacement of the arytenoid and sewing back of the vocal cords. The procedure herein described is so simple that it would seem to merit trial in human beings.

475 Commonwealth Ave.

Dr. Leopold Reiter, of the Pathological Department of the Beth Israel Hospital, made available much of the postmortem laryngeal material. Dr. Arthur Gorney, Dr. Felix Rodriguez, and Mr. Thomas Barnett assisted at the experiments.

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Hydrocortisone-Antibiotic Therapy in Upper Respiratory Infections

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As long ago as 1949 it was observed [1] that intramuscular or oral administration of the adrenocortical hormones resulted in a beneficial effect on inflamed nasal tissue; however, the use of these hormones in the commonly prescribed doses is accompanied by difficulties of administration and risks of side-effects,* which considerably lessens their value. Recently, several investigators † have reported that an extremely dilute (0.020%) solution of hydrocortisone combined with two vasoconstrictors ‡ is a safe, considerably effective local therapy for ameliorating allergic inflammation and for reducing nasal polyps. The preparation was found to be of less value in treating acute rhinitis, and a very limited investigation [4] suggested that the addition of antibiotics to the solution might provide a more effective therapy for inflammations of the nasal mucosa which are caused or accompanied by bacterial infection. Accordingly, the present study was undertaken to determine what value, if any, a topically applied hydrocortisone-antibiotic combination § might have in treating a wide variety of upper respiratory infections.

METHOD

This study was conducted over an eight-month period on 109 patients who were seen in private practice and at the Union Health Clinic, Philadelphia. Eighty-five patients suffered from an out-and-out acute respiratory infection or one superimposed upon some underlying pathology. In order to determine whether the preparation might be effective in any upper respiratory complaint, 24 patients were observed who suffered from one of the following conditions: hay fever (3 patients), chronic hyperplastic ethmoiditis (7 patients), allergic vasomotor rhinitis (12 patients), or chronic nasopharyngitis (2 patients).

The medication, which was dispensed by drops and by means of a plastic spray bottle, had the following formula: hydrocortisone alcohol, 0.020%; hydroxyamphetamine hydrobromide, 0.500%; phenylephrine hydrochloride, 0.125%; gramicidin, 0.005%; neomycin sulfate, 0.100%; polymyxin B sulfate, 0.2000 unit/ml.

Patients were instructed to instill 3 squeezes of the spray bottle or 1 dropperful (the dropper is dosage-adjusted) of the solution into each nostril every three hours; each method delivers 0.2 cc. of the medication to each nostril. The efficacy of the medication was determined in two ways: objectively, by clinical observation of the nasal membrane, and subjectively, by interviews with the patients.

RESULTS

Objective results were evaluated by the following criteria: "Excellent," a complete remission of infection within one week; "Good," a complete remission of infection within two weeks; "Fair," a complete remission of infection within one month; "Poor," an incomplete remission of infection after one month of treatment.

The chief criterion for measuring subjective improvement was the duration of relief of nasal blockage. If relief lasted for seven or more hours the result was considered "Excellent"; for from four to six hours, "Good"; from two to four hours, "Fair"; less than two hours or relief accompanied by undesirable side-effects, "Poor." Of the

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* References 2 and 3.

† References 4 to 6.

‡ Vasocort (Smith, Kline & French Laboratories, Philadelphia).

§ Trisocort (Smith, Kline & French Laboratories).

entire 109 patients the objective results were "Excellent" in 21, "Good" in 70, "Fair" in 10, and "Poor" in 8. The subjective results were "Excellent" in 1, "Good" in 81, "Fair" in 18, and "Poor" in 19.

Of the 85 patients who suffered from a definite acute upper respiratory involvement, the objective results were "Excellent" in 19, "Good" in 62, "Fair" in 1, and "Poor" in 3. Of the other 24 patients, results were "Excellent" in 2, "Good" in 8, "Fair" in 9, and "Poor" in 5.

The subjective results of the 85 patients suffering from upper respiratory infections were "Excellent" in 1, "Good" in 70, "Fair" in 11, and "Poor" in 3. The subjective results in the remaining 24 patients: "Excellent," 0; "Good," 11; "Fair," 7; "Poor," 6. A complete listing of objective and subjective results for each indication is given in the Table.

Summary of Results

Condition Treated	No. Patients	Objective Results				Subjective Results			
		Excellent	Good	Fair	Poor	Excellent	Good	Fair	Poor
Acute upper respiratory infection.....	60	16	42	1	1	..	54	5	1
Residual upper respiratory infection...	3	1	2	..	..	..	3	..	..
Acute upper respiratory infection and vasomotor rhinitis	15	1	12	..	2	1	9	3	2
Acute upper respiratory infection and chronic sinusitis	4	1	3	..	..	..	3	1	..
Acute upper respiratory infection and chronic hyperplastic ethmoiditis.....	3	..	3	..	..	..	1	2	..
Hay fever	3	1	1	..	1	..	2	..	1
Chronic hyperplastic ethmoiditis.....	7	..	4	2	1	..	3	3	1
Vasomotor rhinitis	12	1	3	6	2	..	6	3	3
Chronic nasopharyngitis	2	..	..	1	1	..	..	1	1
Total.....	109	21	70	10	8	1	81	18	19

The medication was very well tolerated by the great majority of patients. Only four patients had any objections to the medication: Two patients complained of nausea, one of severe headache, one of the taste, and one patient thought the medication caused him to develop an allergic reaction. There were no serious side-effects observed in the entire group. There was no evidence of tissue rebound.

The vasoconstrictors afforded a marked and long-lasting (average: three to five hours) relief of nasal congestion, which, in most patients, resulted in sufficient drainage to relieve the symptoms arising from nasal obstruction and discharge (i. e., cough, postnasal drip, headaches). There was, it is felt, sufficient objective evidence to indicate that the hydrocortisone provided an amelioration of inflammation; the antibiotics, a decided lessening and gradual disappearance of bacterial activity.

COMMENT

In analyzing the results of the study, it is apparent that certain criteria, although they are established empirically, are difficult to apply exactly. Although many patients reported that their symptoms cleared in about a week and although there was objective evidence to substantiate their claim, some of them did not return for observation until two weeks had elapsed. Therefore, the difference between the "Excellent" and "Good" responses was difficult to determine, and many of these responses could have been interpreted as belonging to either group.

Then, too, the patient's report on the duration of subjective relief may be somewhat unreliable, and the interpretation of results based on arbitrary time limits (e. g., three to four hours, "Fair"; four to five hours, "Good") may frequently be less than accurate; so there is a good deal of latitude that necessarily accompanies the interpretation of these results.

However, while bearing in mind the limitations to which a study of this nature is subject, it would seem probable that the following conclusions can be drawn from it:

1. The medication is a well-tolerated, effective treatment which provides an immediate (within 15

minutes) and long-lasting (average: five to six hours) relief of nasal congestion free from tissue rebound.

2. It is of considerable value in treating acute upper respiratory infections and provides first a decrease in and later an absence of bacterial activity and nasal discharge.

SUMMARY AND CONCLUSIONS

The study was conducted over an eight-month period on 109 patients (85 suffered from an upper respiratory infection; 24 from uninfected inflammations of the nasal mucosa) in order to test the efficacy of a medication containing a very dilute (0.020%) solution of hydrocortisone plus two vasoconstrictors and three antibiotics. Both objective and subjective results were evaluated.

Of the 109 patients the objective results were considered "Excellent" in 21, "Good" in 70, "Fair" in 10, and "Poor" in 8.

The subjective results were "Excellent" in 1 patient, "Good" in 81, "Fair" in 18, and "Poor" in 19. A complete listing of objective and subjective results for each indication is given in an accompanying table.

It was concluded that, for most patients, the medication is a well-tolerated, effective treatment which not only provides an immediate and long-lasting (five to six hours) relief of nasal congestion but also is of considerable value in decreasing bacterial activity and in ameliorating nasal inflammation.

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Aural Changes in the Embryo of a Diabetic Mother

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Discussion on the combination of diabetes with ear disease is 100 years old. In his historical survey Lederer (1926) mentioned Jordão as the first to have published, in 1857, a case history of diabetes accompanied by deafness.

Leaving aside considerations as to the eczematous and other skin conditions in the external auditory canal that are frequently found in diabetes, these hundred years have seen great variations in the manner in which the topic has been handled. The first symptoms to attract attention were deafness and dizziness. During the period of great and rapid advance in temporal bone surgery the interest switched to diseases of the middle ear and their complications, and the destructions caused by diabetes were recognized as of a particularly vicious nature (the "diabetic, necrotic otitis media" of the textbooks). Lately, sulfonamides and antibiotics have reduced the destructivity of the inflammatory process, and insulin has taken over control of the basic condition, in place of the—at least from the surgical viewpoint—ineffective dietary measures. With the rapid and deep devastation thus checked, functional disorders, deafness and dizziness, have gained once more the foreground. But, while in previous periods stormy middle-ear processes and their intracranial complications controlled the fate of the patient, now, according to the statement of Joslin (1954), insulin hides the tragic symptoms and signs of the disease and thus allows to burrow, unobserved, the slowly developing arteriosclerosis that finally kills. This sequence gains a particular importance regarding the hearing organ, as, from the very beginning, numerous workers assigned any alteration in the latter not to the underlying diabetes as a specific agent but to the concomitant arteriosclerosis.

Even prior to sulfonamides, antibiotics, and insulin, there was some discord about the reciprocal frequency order of the middle- and inner-ear manifestations. Morhenn (1926) considered inner-ear symptoms as being practically unimportant compared with episodes in the middle ear, adding that a diabetic labyrinthitis is always a tympanogenous one. But already von Noorden (as cited by Wertheim, 1924) considered the "pure" hearing loss to be more frequent than otitis media. Krepuska and Krepuska (1936) expressed the view now generally accepted, according to which, in diabetes, the nonsuppurative inner-ear condition, neurolabyrinthitis, is much more frequent than middle-ear inflammations with their intracranial complications. This summarizes the present situation, with diabetes and its concomitant processes checked by up-to-date pharmaceutical and dietary management.

There are very few data about the frequency of changes in the inner ear as associated with diabetes. Edgar (1915) examined 52 diabetics in the medical departments of the University of Vienna and found symptoms connected with the inner ear in 48% of these patients. In Venice, 35 years

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later, Camisasca (1950) found almost the same relationship, namely, hearing loss in 58% of 81 diabetics. Both tabulations bear out the conclusions of Root (1948), according to which the frequent and troublesome ear complications in diabetes present a combination of symptoms resembling Ménière's disease, with sudden onset of dizziness, vomiting, and tinnitus. Schroeder (1954) challenged the generally accepted concept, as he found no hearing loss in 297 patients of the diabetes center in Berlin.

The clinical bibliography on the connection between diabetes and ear disease is voluminous. Pathological knowledge, on the other hand, is based on a mere handful of pathohistological reports. These concern two patients of adult age, one child, and a fourth patient with no age given. According to our knowledge, no description is extant regarding an embryo. An opportunity for study along this line was offered by the case reported in the following account.

REPORT OF A CASE

History

A 26-year-old white woman, wife of a laborer, was known to have been diabetic since the age of 11 years and 8 months. The presenting symptoms were the classical ones of polyuria and weight loss. Her past history and her family history gave no contributory information. At the time of her first visit to the Joslin Clinic, in March, 1951, she gave the history of many insulin reactions, and diabetic coma in 1939. Her general appearance was that of good health. She had never shown albuminuria or hypertension.

Her eyes were examined in January, 1948, and again in August, 1949, by Dr. Karl S. Seale, who found them myopic, otherwise normal.

She had had her last menstrual period Oct. 7, 1950. After this time, the eyegrounds exhibited fulminating changes of the nephritic type, with increasing blurring. Dr. Seale's finding on March 20, 1951, was the following: Many small nerve fiber hemorrhages; some mulberry in type (aneurysmal dilatations). New capillaries visible; central portion right up to disc and few along superior nasal edge of the disc, also above macula and in nasal portions of left fundus. Many areas of edema and cotton-wool exudate scattered throughout fundi, worse in OS. Moderate distension of retinal veins, Grade I sclerosis.

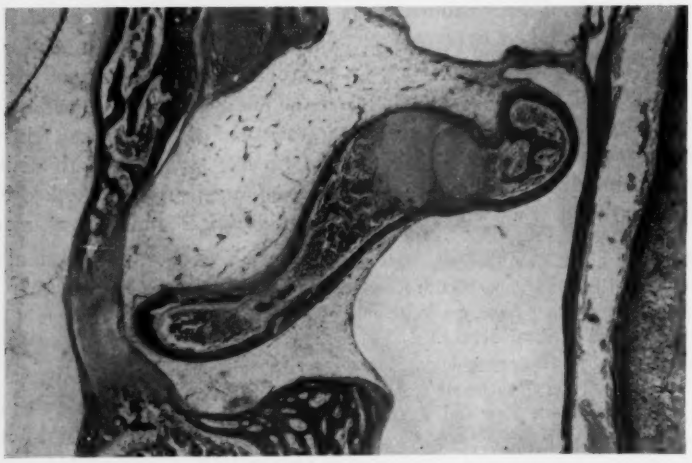
At the Boston Lying-in Hospital, it was thought unwise to continue this pregnancy or to have any future pregnancies, and on March 28, 1951, a routine abdominal hysterotomy and bilateral Irving sterilization was done (Dr. Herbert Bristol Nelson).

After interruption the acute vascular stage subsided in the eyes. As of April, 1951, she showed slight improvement in her eyes, although the basic retinopathy continued.

Ear-nose-throat examination and history Feb. 3, 1955, revealed the following: Tonsillectomy and adenoidectomy around the age of 7; after colds, cervical nodes appeared frequently. The ear his-

Dr. Priscilla White, member of the Joslin Clinic, furnished the data regarding the diabetic mother.

Fig. 1.—Left ear: External canal; middle ear with facial nerve and stapes; periotic cisterna; the latter and the niche of the oval window filled with mesenchyma; hematoxylin and eosin; reduced ⅔ from mag. × 22.



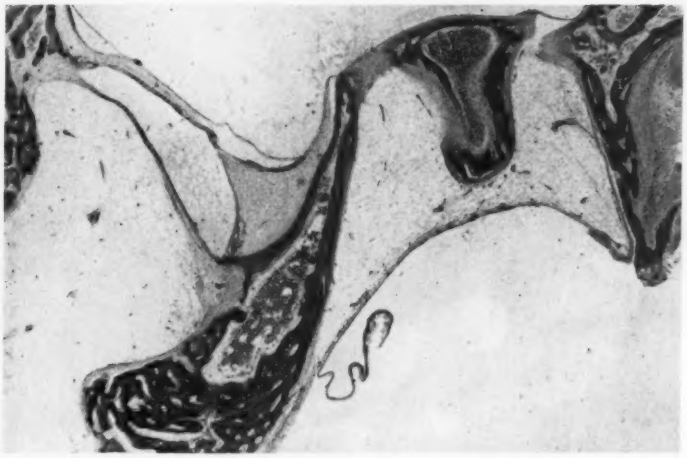


Fig. 2.—Left ear: Mesenchyma in oval and round windows, in the vestibular and the tympanic scala; cochlear duct free of mesenchyma; hematoxylin and eosin; reduced ⅔ from mag. × 22.

tory was negative. She had enlarged lingual tonsils, showed small tabs in both tonsillar fossae, otherwise normal conditions in ears, nose, throat, and larynx. The audiometry (Winthrop Foundation, Massachusetts Eye and Ear Infirmary) revealed normal hearing. No spontaneous signs from the vestibular side; caloric and rotatory tests were omitted because of the condition of her eyes.

The specimen consisted of a nonmacerated male fetus, grossly normal, measuring 160 cm. crown-rump length. Impression (Dr. James A. Merrill, pathologist): Premature, nonviable male fetus. The cranial base was received in the Mosher Laboratory, Massachusetts Eye and Ear Infirmary; no other organ was submitted to further examination. The placenta offered the following diagnosis: Premature placenta, 24 weeks menstrual age, showing patchy, villous edema.

The temporal bones were embedded in celloidin and decalcified. Serial sectioning was done on the horizontal plane at the right side and in the vertical on the left. Hematoxylin and eosin, Heidenhain-Mallory, and some auxiliary stainings were applied; a number of sections containing the organ of Corti were stained according to McManus with the periodic acid-Schiff reaction.

The histological work was done by Miss Dorothy Linden; the microphotography, by Mr. Richard St. Clair.

Fig. 3.—Left ear: Cartilage nucleus around the subarcuate region. Vessel-carrying protrusions in wheel-spoke disposition initiate reabsorption of the cartilage previous to the formation of permanent bone. Hematoxylin and eosin; reduced ⅔ from mag. × 22.

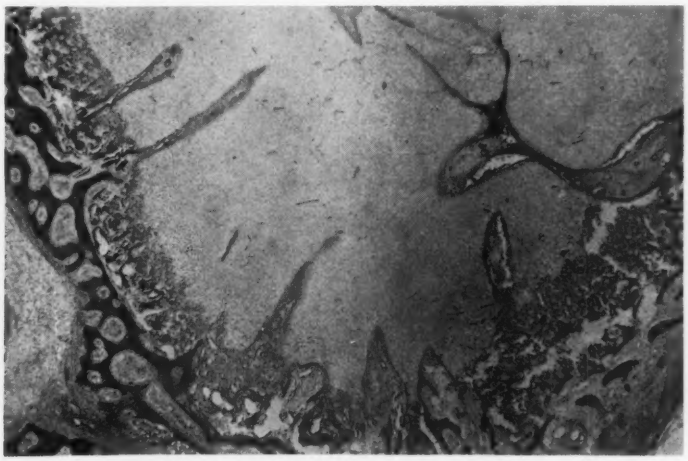


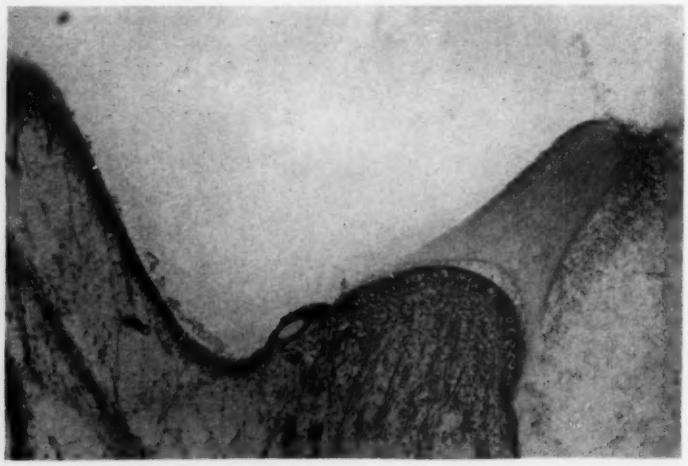
Fig. 4.—Right ear: Stapes plate, with bone on the tympanic and cartilage on the vestibular side. In the obturator foramen ruptured capillary surrounded by extravasate. Hematoxylin and eosin; reduced ⅖ from mag. × 100.

Observations in the Temporal Bones

Both ears were found in the appropriate developmental stage corresponding to the sixth embryonic month. The external meatus showed already high papillary structure in the skin around its upper corner. The tympanic membrane (Fig. 1) included the intermediate fibrous layer. The tympanic ring was solidly formed. Malleus and incus were ossified with a continuous corticalis outlining their contours. The crura of the stapes (Figs. 1 and 2) had become osseous, and bone was seen on the tympanic aspect of its base (Fig. 4). The great cartilage block in the subarcuate region (Fig. 3) was in resorption by concentrically penetrating vessels. Pneumatization of the tympanic cavity was far advanced. The tubal corner and the hypotympanum were entirely free from mesenchyma; large accumulations of the latter (Figs. 1, 2, and 4), especially in the niches and around the ossicles, showed it to be a loose, almost mucoid tissue, with few vessels. Pneumatization of the peritympanic air cells was advancing.

The fissula ante fenestram could be clearly distinguished. In the inner ear, the endosteal bone firmly outlined the spaces of the cochlea (Fig. 9), with the periosteal layer already acquiring more thickness and the middle layer represented by spicules of endochondral bone surrounding marrow

Fig. 5.—Left ear: Ampullar crista, fully developed and intact with hair cells, while the cupula begins to disintegrate at the side where the hemorrhage reached its surface. Hematoxylin and eosin; reduced ⅖ from mag. × 100.



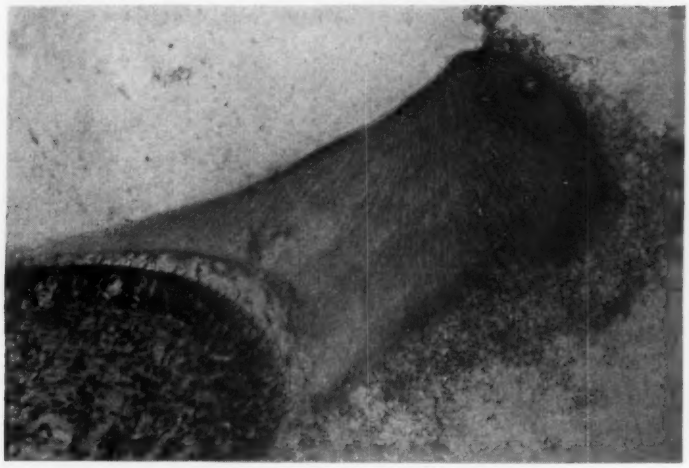


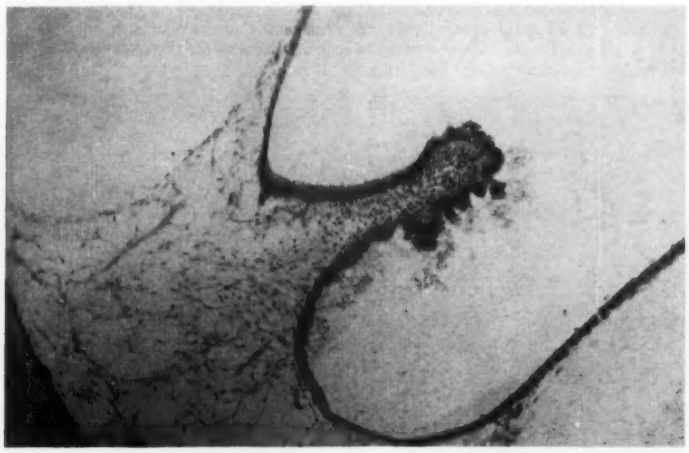
Fig. 6.—Left ear: Ampullar crista. Supporting and nervous elements intact; cupula disintegrating at the side of impact of the hemorrhage. Hematoxylin and eosin; reduced ⅖ from mag. × 200.

spaces. The cristae ampullares (Figs. 5 and 6) were fully developed together with their cupulae, while the maculae did not reach their definite differentiation. A crista quarta (Fig. 7) was conspicuous. Corti's organ (Figs. 10 and 11) showed well-delineated elements around the tunnel, in all the turns. The tectorial membrane (Figs. 10 and 11) was firmly adherent to the tips of the hair cells. Spiral ligaments (Figs. 10 and 11) with stria vascularis, including the vas prominens, were present, while the vas spirale did not yet appear under the basilar membrane. The mesenchyma was generally cleared everywhere from the otic spaces, while it persisted in the periotic portions (Figs. 2, 4, 5, 6, 7, 9, 10, 11, and 12); in some parts the vestibular and in others the tympanic scala appeared more free. In the vestibulum (Figs. 1, 2, 4, 5, 6, and 7) the otic space was almost completely free of mesenchyma, with the periotic spaces showing different degrees of filling.

While this general outline is valid for both sides, the pathological findings are reported separately for the right and the left side. These manifested themselves as hemorrhages.

In the right middle ear, extravasates surrounded mesenchymal capillaries similar to the one in the obturator foramen between the stapedial crura (Fig. 4). The inner ear showed engorgement of the modiolar vessels surrounded by extravasates (Fig. 8), especially conspicuous around the apical

Fig. 7.—Left ear: Crista quarta with hemorrhage from one side; hematoxylin and eosin; reduced ⅖ from mag. × 100.



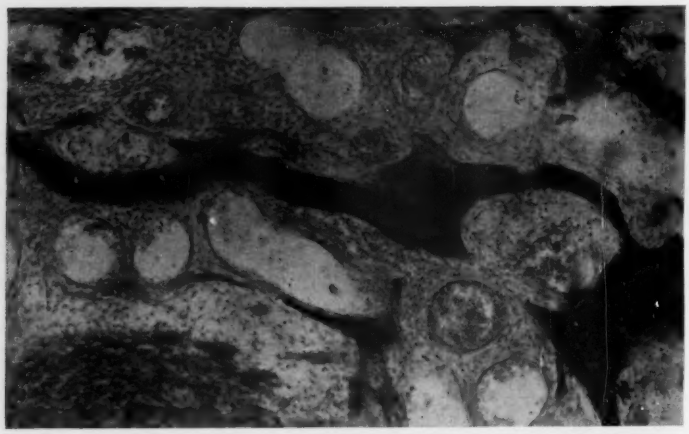


Fig. 8.—Right ear: Cochlear modiolus: vessels engorged and surrounded by extravasates. Nervous elements intact. Hematoxylin and eosin; reduced ⅔ from mag. × 100.

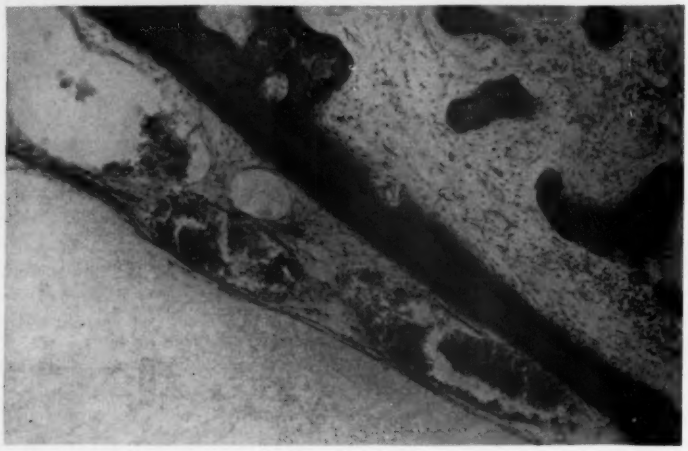
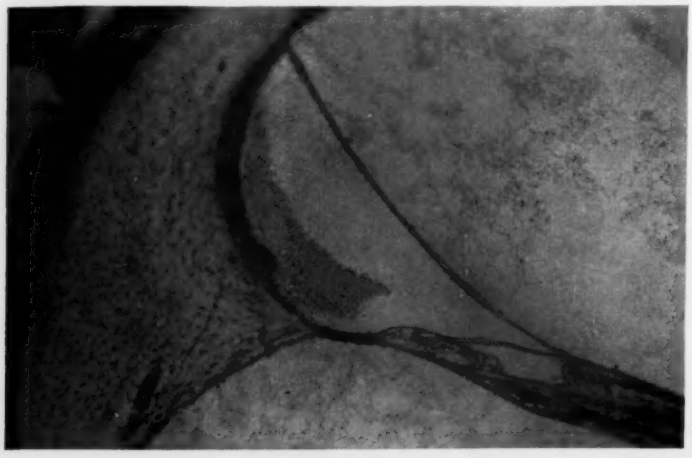


Fig. 9.—Right ear: Cochlear capsule at apical turn. Endosteal layer represented by continuous bone; enchondral layer, by spicules surrounding marrow spaces. The endosteal lining contains engorged vessels surrounded by extravasates. Hematoxylin and eosin; reduced ⅔ from mag. × 100.

Fig. 10.—Left ear: Middle turn of cochlea. Vestibular and tympanic scalae filled by mesenchyma; cochlear duct free from the latter. Vessels in the spiral ligament engorged; bleeding from the capillaries of the stria around the vas prominens; the extravasate moving in the direction of Corti's papilla. Tectorial membrane adherent. Reissner's membrane in normal position. Hematoxylin and eosin; reduced ⅔ from mag. × 100.



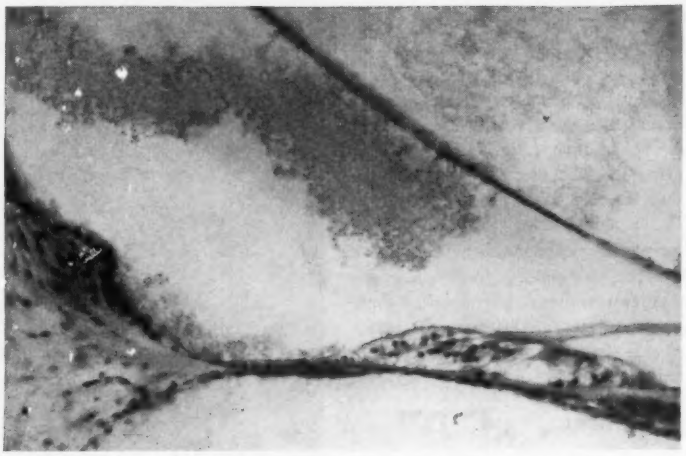


Fig. 11.—Left ear: Apical turn of the cochlea. Vestibular and tympanic scalae filled by mesenchyma; cochlear duct free from the latter. Bleeding from the stria starts above the vas prominens, and its main flow is directed against the membrane of Reissner, which retained its normal position. A smaller portion of the extravasate gliding along the cells of Claudius, invading the area of the cells of Hensen. Tectorial membrane adherent. Hematoxylin and eosin; reduced 2/5 from mag. × 200.

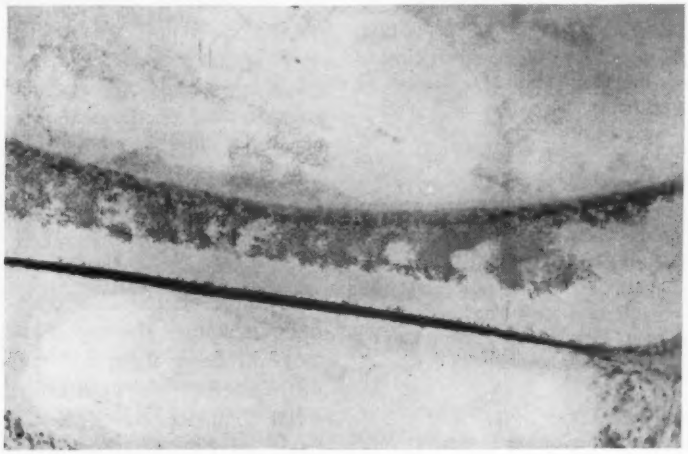
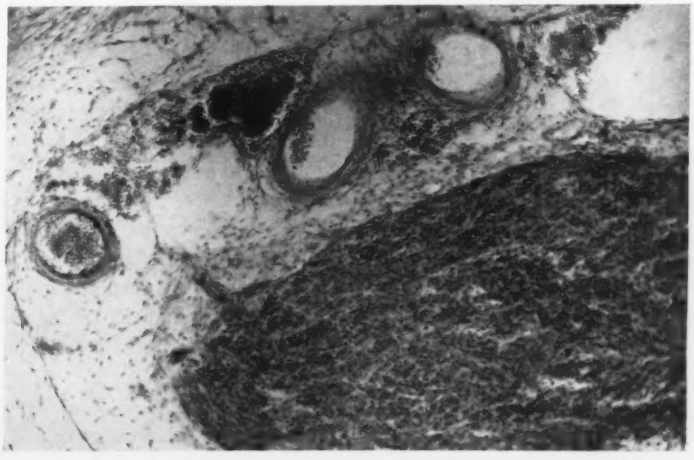


Fig. 12.—Left ear: Apical turn of the cochlear duct, in tangential section, which shows it filled with blood (compare with Fig. 11). The extravasate is adherent to Reissner's membrane, which is in normal position. Hematoxylin and eosin; reduced 2/5 from mag. × 100.

Fig. 13.—Left ear: Inner acoustic meatus. Nerve trunk at this level intact; in the perineurium engorged vessels surrounded by extravasates. Hematoxylin and eosin; reduced 2/5 from mag. × 100.



end of the modiolus. High-grade engorgement with extravasates around the vessels was seen in the endosteum of the apical turn (Fig. 9), which thus was far from being the thin membrane seen under normal conditions. Free bleeding occurred into the cochlear duct of the apical turn.

In the left ear the hemorrhages were even more conspicuous. In the vestibulum free blood approached the cupulae mainly from one side (Figs. 5 and 6), making the difference between the intact and the attacked side very conspicuous. The cristae themselves were intact. Blood surrounded the crista quarta (Fig. 7).

In the cochlea, the bleeding originated from the vessels of the vascular stria (Figs. 10 and 11); consequently, the extravasates were limited to the cochlear duct. The vessels in the spiral ligament were engorged (Fig. 10), while superficially placed vessels of the stria ruptured with blood pouring from them (Figs. 10 and 11). The blood flow was directed in the middle turn against the papilla (Fig. 10), in some areas entering the papilla itself (Fig. 11); in the apical turn the flow was directed against Reissner's membrane (Fig. 11). Here, in the apical turn, tangential sections (Fig. 12) showed the entire cochlear duct filled with blood. At one sector the lateral edge of the tectorial membrane was eroded by bleeding.

In the inner meatus blood was found on the wall of the fundus around torn vessels.

The vessels in the sheaths of the eighth nerve were engorged with extravasates around them (Fig. 13). Other sections showed blood in the nerve trunk itself (Fig. 14), prying its bundles apart. Thus, perineural and endoneural bleeding was encountered.

Fig. 14.—Left ear: Inner acoustic meatus: endoneural extravasates. Heidenhain-Mallory; reduced ⅔ from mag. × 200.

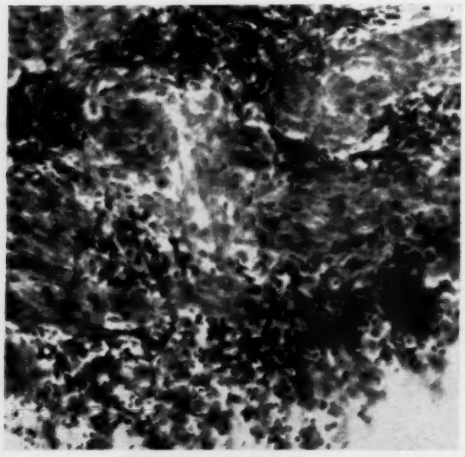


Fig. 15.—Left ear: Corti's papilla showing selective staining of the tectorial and the basilar membranes; McManus; reduced ⅔ from mag. × 200.

In sections stained according to McManus (Fig. 15) Corti's papilla was just outlined, while the basilar and the tectorial membranes were electively stained, the latter more heavily.

Nowhere, on either side, was a dilatation of the otic spaces noted. Reissner's membrane was everywhere in normal position (Figs. 10, 11, and 12).

COMMENT

It would be desirable to set the presented findings against the appropriate background by confronting them with pertinent reports in the literature. The extant pathologic material comprises a very few cases, some of them offering only macroscopical description.

In the case of Raynaud (1881) a 67-year-old man died after profuse bleeding from the ear. The autopsy was performed by Ladreit de la Charrière, who found, by macroscopical dissection, an otitis media with osteitis of the mastoid cells.

In a case of hemorrhagic-suppurative otitis media in a diabetic (age not given), Steinbrügge (1891) observed microscopically engorgement and extravasates in the labyrinths, on both sides. They were encountered on the periosteum of the inner meatus, between the bundles of the acoustic nerve and its branches, between the ganglionic cells of Rosenthal's canal, in the spiral ligament, in the endosteum of the vestibulum, on the

epithelium of the end-organs, and in the ampullae. Free blood cells were seen in the perilymphatic spaces and in the cochlear aqueduct.

The diabetic patient of Manasse (1904), a 64-year-old man, died one day after operation had disclosed a perisinuous abscess. The vestibulum contained hyalin, fibrin, and pus, with the membranous parts nearly completely destroyed. There were endolymphatically and perilymphatically hyalin fibrin and pus in the cochlea also. The cochlear duct was entirely filled by a glassy hyaline substance; the epithelial elements of the stria were found in a state of intensive proliferation, with three to four cell layers and conspicuous pigmentation. The propagation from middle to internal ear occurred through the annular ligament, resulting in peracute internal otitis and suppurative meningitis. Inflammatory affection of the cochlear ganglion was present. Corti's organ was in a state of perfect preservation.

Wittmaack's (1906-1907) description concerned a 10-year-old girl who died in a diabetic coma. With the vestibulum normal, the cells of the organ of Corti were in their greater part disintegrated, with hyaline globules in the tunnel and in the space of Nuel. He considered this condition to be the basis of the nerve deafness seen in less severe cases of diabetes. This conclusion has probably to be interpreted according to the observation at that period that the more severe cases showed up in the form of the dreaded, rapidly destructive inflammatory processes.

Among these four cases, three (Raynaud, Steinbrügge, and Manasse) emphasized hemorrhages as the outstanding finding. From the beginning bleeding was known to characterize the "otite diabétique" (Raynaud, 1881), after Toynbee (quoted by Lederer) had recognized its destructive character. Politzer (1909) enumerated the conditions causing hemorrhages, extravasations in the labyrinth. Besides injuries, these are typhoid, variola, scarlet fever, diphtheria, mumps, nephritis, diabetes, leukemia, pernicious anemia, sudden cessation of menstruation, caisson disease, diving, and suffocation. Schwartze (1885) listed heart and kidney affections, atherosclerosis, typhoid, scarlatina, measles, mumps, and arthritis as causing extravasation in the labyrinthine spaces and organs. He, as others, discussed the connection of these lesions with Ménière's disease, questioning the nature of the latter to be a primary labyrinth bleeding or an inflammatory process. Alexander and Manasse (1908) considered multiple hemorrhages in the labyrinth and eighth nerve as the basis of Ménière's disease.

The findings as reported here are in harmony with the few observations of others emphasizing a hemorrhagic tendency. Schwartze (1885) regarded only large accumulations in the labyrinth as pathological. Here the postulate of Mosher (1938) is accepted, according to which bleedings in the labyrinth are considered as originating in vivo when they are found in the immediate vicinity of the damaged vessel. The engorgement and extravasation seen in the nerve sheaths (Fig. 13) finds parallels in Grünberg's (1909) cases of sepsis with hemorrhages in the modiolus and in the sheaths of the acoustic nerve and in the nephritic case of Lynch (1912), who found edema of the nerve sheaths responsible for tinnitus and deafness.

Scarcity of material regarding diabetes itself leads by necessity to a search for conditions which produce comparable pictures in the inner ear. Two groups are discussed here: conditions in early life periods characterized by hemorrhagic tendency, which were studied pathologically, and nephritic lesions, because of their close connection with the later stages of diabetes.

Of the first group only those are cited here which can be discussed on the basis of personal observations. Baratoux (1887) considered bleedings in the middle and inner ear as characteristic of hereditary syphilis. These were found again (Kelemen, 1929) but declared to be probably agonal, with the exception of those within the modiolus. Vascular damage was seen in embryonic hearing organs after maternal

rubella (Schall, Lurie, and Kelemen, 1951) and was produced experimentally in rat embryos exposed to x-ray irradiation in utero (Kelemen, 1955).

Besides arteriosclerosis, the condition in most intimate connection with diabetes, as characterizing its later stages, is nephritis. Here, concerning pathohistological experience around the hearing organ, one finds oneself on much safer ground. Rayer (1839-1841) already had recorded connection between pathological processes in the kidneys and the ears. Liebermeister (1861) mentioned ear noises in nephritis. Schwartze (1869) and again Buck (1871) saw blood in the middle ear; Schwartze, in the inner ear also. Grahe (1924) observed extravasation in the mastoid process, in the middle ear, and in the inner meatus. Localizations of hemorrhage in Grahe's cases, comparable to those described in the present report, were the following: in the obturator foramen between the stapedial crura; around the vestibular end-organs; in the modiolus—engorgement and extravasates; in the porus internus, where bleeding pried apart the bundles of the cochlear and of the vestibular branch without destroying them. The sensory end-organs were free in all his observations, as they were similarly, amid bleeding, in the case here presented; as here, there was no displacement of the labyrinthine membranes, even after high notations regarding blood pressure in his cases. According to Grahe's opinion, the bleedings in the inner ear originated without doubt intra vitam, while agonal bleedings as observed in the middle ear left the inner ear untouched. He summarized his analysis by ascribing the bleedings to vascular changes confirmed by observations on other parts of the organism and saw no basis to concede any role to elevated blood pressure in the production of hemorrhages.

In nephritis the reports concerned mostly persons of middle or advanced age, records on embryos seemingly being nonexistent.

As to lesions in organs outside the ear in diabetes, the best known and most exactly formulated are those seen in the eye by ophthalmoscopy, although Grahe (1924) cautioned against giving too much credit to the parallelism between eye and ear. Diabetic retinopathy is characterized by manifold variations of hemorrhagic signs, and diabetic iridocyclitis by tendency to the formation of new vessels. According to Adler (1953), progress of late toxemia of pregnancy can be gauged by the changes in the severity of the retinopathy, which does not differ from the retinopathy seen in any other hypertensive disease. It is interesting to note that while, according to Adler, the eyeground changes depend largely upon the degree and duration of the hypertension, the impact of this factor on the histological picture in the inner ear, with nephritis, is denied by Grahe even when he observed a fluctuation in the hearing acuity as moving parallel to the development or disappearance of edema.

As studies on retinal pathology yielded some results with application of staining according to McManus (Root, 1952), the demonstration of fixed carbohydrate was tried in the present series by this method. Selective staining of the tectorial and the basal membrane was obtained. However, as Zorzoli and Zorzoli (1954) and Wislocki and Ladman (1955) found selectivity in the identical location in normals, no significance regarding diabetes could be attributed to these findings.

The combination of bleedings with diabetes being a well-established fact, it is of interest to discuss the ability of hemorrhage to cause functional defect. Dieulafoy (1877) ascribed deafness in Bright's disease to circumscribed hemorrhages. Raynaud (1881) emphasized the role of bleeding; Downie (1885) explained immediate loss of hearing by the rupture of small arteries and consequent extravasation of their contents. Schwartze (1885) believed that even with hemorrhages in the vestibulum and in the semicircular canals the result may be complete deafness because of sudden elevation of hydrostatic pressure and consecutive paralysis of the acoustic nerve. Hegener (1908) thought that small hemorrhages might very well damage a large sector of the end-

organs simultaneously; this explains unilaterality in the functional finding and the tendency to spontaneous restitution by reabsorption. Richards (1907) wrote that diabetes seems to predispose to vascular changes, as shown by sinus thrombosis in one of his cases and a subcortical hemorrhage and sinus thrombosis in another. According to von Noorden (as cited by Wertheim, 1924), diabetic damage to hearing originates indirectly by arteriosclerosis. Lederer (1926) found hemorrhageous signs on the part of the middle ear in diabetes to be equally frequent with "genuine" otitis media.

White (1943), who tabulated a fetal mortality of 12% for pregnancies during the course of well-established diabetes, found among the causes of death subtentorial hemorrhage and hemorrhagic disease of the newborn.

Toxic neuritis being known to develop with high frequency in the auditory nerve, diabetic hearing damage was attributed by some to degenerative factors. Edgar (1915) assumed direct toxic action to the labyrinth, arteriosclerosis, or a combination of both. Manasse (1917) placed the chronic progressive perception deafness in diabetes among the group of degenerative atrophies of the labyrinth. Marullo (1950) explained the inner-ear deafness by the tendency of diabetes to early degenerative lesions. By alloxan poisoning, Cojazzi (1950) produced degenerative changes in the cells of the (spiral) ganglion of Corti and the (vestibular) ganglion of Scarpa.

Morhenn (1926) found even in the preinsulinic era an improvement of the hearing with lowering of the sugar content of the blood; later Krepuska and Krepuska (1936), who considered the lesions as a neurolabyrinthitis, stated that the hearing improved with treatment of the basic condition and reported remarkably good results with insulin.

As the findings here presented relate to an embryo, a few remarks on the progeny of diabetic mothers seem to be in order. Diabetes is believed (Duncan and Fetter, 1949) to be carried as a recessive Mendelian trait. and so the child cannot inherit the disease from the mother alone, unless the father has diabetes also or carries a recessive factor for diabetes. White (1952) found congenital anomalies, usually of mesenchymatous-tissue origin, in 80% of the infants of diabetic mothers compared with the expected incidence of 1.8%.

White (1952) pointed out that in diabetes the onset in youth of a clinically recognizable form of vascular disease becomes manifest between the 10th and the 15th year of the disease with sites in the retina and kidney. To these one can probably add a hearing loss. Krepuska and Krepuska (1936) revealed that not infrequently deafness is the first symptom of diabetes.

Some reflection might be given to the fate of the hemorrhages found in the ear of the embryo if the pregnancy had been continued. Termination of hemorrhages into the inner ear presents the following possibilities (Politzer, 1909): absorption, inflammation which may end in suppuration, organization of the exudate, and atrophy and degeneration of the epithelial and the connective tissue and of the nervous elements. None of these can be excluded here. None of the infants of the patients of White (1943) had developed diabetes up to the time of the observation. In her experience retinopathy was characterized by superimposition of renal retinopathy. The impression remains that with the onset of renal complications the vascular damage in the inner ear could become manifest by hearing loss in the form of a delayed symptom. However, to discuss whether the end-result would have been complete restoration by reabsorption or an intrauterine or neonatal otitis or, again, a partial or total degeneration of the eighth nerve would remain pure guessing.

On the other hand, it is probably permissible to venture the following reflections regarding reversibility of the lesions. The vascular damage might not become manifest until the middle years of extrauterine life, and so it hardly can be evaluated. But the actual bleedings as seen here might be subject to reabsorption; and, as the cochlear

end-organ was undamaged, unimpaired function could be expected. Manasse (1904) pictured similarly intact Corti organs amid changes in the cochlea which were much more severe than the ones seen here. The vestibular end-organs in the present case were undamaged at the time of the interruption, with exception of the cristae, which suffered severely under the impact of hemorrhages. There is no way to know whether a cupula can regenerate, even when the crista to which it belongs remains unimpaired. The damage to the acoustic nerve, especially that caused by intraneural hemorrhages, described by Steinbrügge (1891) and again here, can hardly be considered as subject to regeneration.

Although this report stands alone of its kind, one can set it within the framework of related conditions, as has been attempted here. The findings ask imperatively that in the progeny of diabetics there be given to the condition of the hearing organ as close and as early attention as is granted to other regions of the organism.

SUMMARY

The pregnancy of a 26-year-old mother, known to have been a diabetic for 15 years, was interrupted by hysterotomy in the sixth month, as her rapidly progressing retinopathy threatened to advance to complete blindness.

In the ears of the embryo, which had reached a normal developmental stage corresponding to the period, hemorrhages were found in several locations: in the mesenchymal cushion of the middle ear; in the otic spaces of the vestibulum, with heavy damage to the cristae, limited, however, to their cupulae; in the endosteum and in the modiolus of the cochlea; in the scala media, but with Corti's organ everywhere intact; in the perineurium and between the bundles of the eighth nerve.

As this report is the first of its kind, an attempt was made to gain a background for comparison by placing its findings within the framework of comparable pathologic conditions.

Unique as the case is for the time being, it lends some basis to the clinical experience according to which signs and symptoms on the part of the ears may be the first to come to attention in diabetes, and it pleads for closer study of the hearing organ in the progeny of diabetic mothers.

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Psychosomatic Aspects of the Temporomandibular Joint Syndrome

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Through the work of Costen and others the concept of a temporomandibular joint syndrome has become well known and widely accepted. This concept is now an integral part of the working knowledge of the clinician. Considerable literature from medical and dental sources has accumulated. However, there have been few references indicating a psychosomatic relation to the syndrome. This is interesting, since in personal experience as well as in the experience of colleagues with whom the matter has been discussed it appears that many cases of temporomandibular joint disturbance have a definite psychosomatic aspect. A discussion of the psychosomatic relation to the temporomandibular joint syndrome is the basis of this report.

HISTORICAL REVIEW

In 1920 W. H. Wright [33] reported a case in which deafness was relieved after correction of malposition of the mandibular joint. G. H. Wright [32] in 1925 discussed the importance of malposition of the mandibular joint and head pains. In 1933 Goodfriend [18] contributed to the dental literature on the subject.

Costen [5] made his original report on the subject in 1934. He delineated the components of the syndrome which bears his name. In a series of contributions * over a period of 20 years he has elaborated on the syndrome and added to our knowledge of it.

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* References 5, 12, and 16.

Seaver [26] credited Wright [32] with introducing him to the condition and reported on mandibular joint dysfunction and the inner ear. He was impressed by the subtlety of the disease, its slow progress, with brief periods of irritative symptoms and long symptom-free periods. Seaver pointed out that during the symptom-free periods it is easy to fail to recognize that nonintermittent symptomatology may not become evident until later life.

Greene [19] in 1937 reviewed the dental conditions most likely to cause disturbance of the mandibular joint. The following year Ernst and Costen [16] reported their roentgen studies relating to the syndrome. Axhausen,[1] Steinhardt,[30] and Bauer [2] investigated and reported the basic pathologic changes in mandibular joint disease.

Bayles and Russell [3] found the temporomandibular joint involved in 51% of 100 consecutive cases of rheumatoid arthritis. Greer and Withers,[20] Epstein,[15] and Poweleit [24] reviewed the syndrome and reported their cases and experience. The dental literature in recent years has contained numerous reports on the condition.†

In 1951 Costen reviewed his experience with the symptom complex and reported his second series of 400 cases, indicating an experience with 800 cases.

PRESENT CONCEPT OF THE SYNDROME

Pathophysiologic Concepts

In the typical condition, dental malocclusion is the cause of the anatomic derangement in the mandibular joint. Those changes in the joint resulting from trauma, bacterial disease, neoplastic disease, and other causes are of less interest in general consideration of

† References 4, 13, 14, 17, and 23.

the syndrome. The anatomic derangement produced by malocclusion may include pathologic changes in the joint structure and/or physiologic changes in anatomically related structures through mechanical disturbance. Seaver [27] pointed out that the joint is normally of a toggle nature and becomes, abnormally, a weight-bearing joint when there is extensive loss of the molar support which maintains normal vertical dimensions within the joint.

The intimate relationship existing between the auriculotemporal nerve and the mandibular joint has been noted by many observers. Costen's investigations have indicated that the pain occurring as a part of the syndrome is a reflex type of neuralgia resulting from impingement of joint structures on this nerve. The lingual symptoms frequently encountered in the syndrome have been explained as a reflection from irritated auriculotemporal fibers to the lingual nerve.

Recent investigations [11] have demonstrated, in the human, the possibility of irritation of the chorda tympani nerve in its relation to the glenoid fossa and have established that this nerve can transmit pain impulses.

The trismus occasionally occurring in the syndrome also has been explained as due to sensory irritation of the auriculotemporal nerve reflected to the masticator nerve.

The sensation of aural obstruction frequently associated with the syndrome has been variously explained. Costen's [7] original contention, developed from investigation of soft-tissue specimens, was that overclosure of the jaw caused bulging of the joint structures which impinged upon and closed the Eustachian tube on its anterior membranous wall. This contention was confirmed, 10 years later, by the work of Shapiro and Truex.[28] Kelly and Langheinz [22] and Sicher [29] contended that the causative factor of Eustachian tube obstruction was a lymphedema of the Eustachian tube resulting from loss of the milking action of the incoordinated buccinator and superior pharyngeal constrictor muscles.

Seaver [26] advanced the concept that malocclusion is an abnormal posture which initiates abnormal proprioceptive impulses that create abnormal muscle tone through reflex action. He postulated that the tensor tympani muscle also received these abnormal impulses with resultant increase in interlabyrinthine pressure through the ossicular chain.

The true pathologic changes incurred by the joint as a result of malocclusion appear to be largely irreversible. The physiological disturbances, such as reflex neuralgias and interference with Eustachian tube function, tend to abate or disappear with return of the joint to normal anatomic relations through the correction of the malocclusion.

Clinical Concepts

Costen [10] has stated that the diagnosis of the syndrome depends upon the history, physical examination, roentgen studies, and the test of treatment. The history, physical examination, and roentgen examination have been so thoroughly and repeatedly reported that they now constitute standard working knowledge. It is not pertinent to this paper to review them.

Symptomatic results from treatment directed toward increasing the vertical dimensions and relieving abnormal pressures within the joint have been used to validate the clinical diagnosis. The possibility of error in such a concept has been recognized. However, the concept is clinically expedient.

Cork discs, of a thickness suitable to the case at hand, worn between the posterior teeth, with or without elastic bandage, have been used. Costen recommended this procedure for trial. While relief obtained by this procedure would presumably be temporary, yet it is surprisingly often of long duration.

Dental prosthetic devices of many kinds have been used to obtain temporary or permanent readjustment of the joint. These vary from simple caps for the posterior teeth to full dentures for the edentulous.

Recently myofunctional exercises have been used in the treatment of the condition.

Seaver [27] noted that Froeschels ‡ employed similar exercises in speech therapy. Seaver developed and reported in detail exercises of this nature for use in treatment of temporomandibular joint dysfunction. Costen [12] noted that Rogers [25] used myofunctional exercises in the treatment of malocclusion in children. Costen stated in the report of his second series of 400 cases that the myotonic exercises of Seaver had been a most effective treatment procedure.

PSYCHOSOMATIC ASPECTS

Substantiating literature indicating a psychosomatic relation in temporomandibular joint disease is almost entirely lacking. Costen observed that the degree of pain might be so slight as to cause the observer to suspect that the patient had a chronic complaint with a neurotic background. Later he reported frank psychoneurosis in six patients with the syndrome.[12] Psychosomatic connections have been noted in so many other functional diseases that it would not be unreasonable to presume a similar relationship in the temporomandibular joint syndrome.

Many observers of this syndrome must have been intrigued by the fact that countless patients have a typical dental condition conducive to disturbance of the mandibular joint, yet never develop symptoms. Even with complete loss of molar support for many years, they remain asymptomatic. An observer might readily conclude that in only a relatively small percentage of cases with a dental condition conducive to development of the syndrome does the disease entity actually develop. This question naturally arises: Why do some develop the syndrome, while others, who may have an even severer dental foundation for it, do not?

It was observed clinically that a number of the patients in whom a diagnosis of temporomandibular joint disease had been made presented psychoneurotic symptoms in addition. In some cases aggravation of psychoneurotic symptoms was chronologically related to the onset or recurrence of mandibular joint symptoms.

While the number of cases in this series was too small to permit definite conclusions, the idea seemed sufficiently pertinent to merit investigation.

METHOD

The diagnosis of temporomandibular joint dysfunction was made in 112 patients seen in private practice from 1946 to 1953. A standard form was prepared for the tabulation of all information previously obtained and of new information to be obtained from reexamination and review of the cases. Attempts were made to recall the 112 patients to the office for review and reexamination. Twenty-six patients responded. Their case histories constitute the material for this study.

In addition to the usual history, most of the patients had been previously questioned concerning insomnia, dreaming, and nightmares, especially when the pain had been present on awakening. Interrogation of other patients, who had onset of mandibular pain later in the day, occasionally revealed indication of daytime-constructed nervous tension that manifested itself in various forms.

Most of the patients had obvious dental abnormalities with malocclusion. Some of those with mild symptoms associated with nervous tension had been treated temporarily by sedatives and referred for dental treatment. When severe mandibular symptoms associated with nervous tension were not relieved in a few days on sedatives, salicylates were often added to the treatment in cases where patients neglected to obtain dental treatment. Some of the patients with severe symptoms had been partially or completely relieved by the use of cork discs. This procedure was used most frequently in patients who resisted the idea of a dental cause for their symptoms.

The patients who returned for survey were reexamined and their histories reviewed. They were questioned concerning the frequency and severity of recurrent symptoms. The result of nondental treatment was determined, and where dental treatment had been obtained the type of treatment and results were recorded.

ANALYSIS

The 26 patients who responded comprised 24 women and 2 men. The series included one teen-ager who had developed severe symptoms during orthodontic treatment for malocclusion. The other patients ranged in age from 23 to 71 years:

20-29 years	4 cases
30-39 years	4 cases

‡ Froeschels, E., cited in Hygiene of the Voice.[21]

40-49 years	3 cases
50-59 years	8 cases
60-69 years	5 cases
70-79 years	1 case

Periaural pain was the principal complaint in 25 cases. It was unilateral in 22 cases and bilateral in 3. Duration of symptoms of all kinds varied from a few weeks to 10 years. Long duration tended to occur in patients beyond 50 years of age.

Radiation of the pain occurred in 12 cases. It was related to meals in five cases, to chewing gum in two, and to smoking a pipe in one case.

In 13 the pain was present on arising, in 12 it came on later in the day, in 5 it occurred at night after retiring, and in 6 it occurred intermittently throughout the waking period.

Only 3 patients complained of deafness, although the audiogram was abnormal in 13 cases. In only two of those with abnormal audiograms was the hearing loss of the low-tone type that might be associated with the syndrome.

Tinnitus was a complaint in nine cases. In four of them it was of the mild low-tone type, temporarily relieved by inflation.

A sensation of aural obstruction was present in 10 cases. Six of the patients had discovered that the sensation could be relieved temporarily by opening the jaws. In two cases it could be relieved by inflation, and in two cases inflation could not be satisfactorily performed.

Five patients complained of dizziness, but complaints of vertigo were not encountered.

Pharyngeal symptoms were present in seven cases. In three of these the discomfort was of a burning and aching nature. In four the pharyngeal symptoms were indicative of neurosis of the pharynx.

Lingual symptoms were present in two cases. In both the patient complained of a burning sensation.

Salivary symptoms, present in two cases, were of the dry-mouth type.

Insomnia, initial or secondary, was present in 14 cases. The insomnia was of a severity to interfere seriously with normal sleep. Mild complaints of insomnia were not included.

Frequent dreaming was present in 20 cases and pronounced in 14 of them. Six patients reported frequent nightmares, and four of them said their nightmares disturbed the sleep of their spouses. Of the 13 patients who complained of mandibular joint pain on arising, 11 had frequent dreaming, 5 had frequent nightmares, and 2 denied either dreaming or nightmares.

Headache was a complaint in 14 cases, in 8 of which it was interpreted to be of the nervous tension type. In six of these sedatives had previously eliminated the headache.

Various symptoms of anxiety were present in 19 cases. Nervous tension was manifest in 21 cases, and 18 of the patients considered themselves to be nervous persons.

Physical examination of the ears, nose, and throat generally revealed no significant abnormality. There was one case of mild nasal allergy, one with infected tonsils, one with mild deviation of the nasal septum, and one with severe deviation of the nasal septum. Disease of the middle ear was not encountered in the series.

Results of the examination of the mandibular joint, involving previously noted difficulties, were interpreted with caution. External palpation of the mandibular joint is subject to several objections. In this series, however, external palpation of the joint in the preauricular area, with the joint in motion, revealed tenderness on the side of complaint in 24 cases. Tenderness was bilateral in four cases. Palpation of the joint externally in the preauricular area, with the jaw in occlusion, revealed tenderness on the side of complaint in 10 cases. Tenderness was bilateral in three of them. Palpation of the joint area, from the aural vestibule, with the mandible in motion, revealed tenderness on the side of complaint in 13 cases. The tenderness was bilateral in two cases. Palpation in the same manner, with the jaws in occlusion, revealed tenderness on the side of complaint in nine patients, in two cases bilateral. Internal palpation, with the forefinger behind the posterior pillar, revealed tenderness on the side of complaint in nine cases and questionable tenderness in five cases. The results

were indefinite or the examination unsatisfactory in the remainder.

Dental examination disclosed the absence of any dental cause for the symptoms in only three cases. In 23 cases there were frank dental causes for the temporomandibular joint disturbance.

Of the nine edentulous patients, all wore dentures of some type. In four cases the dentures appeared to be satisfactory, and in five an inadequate or ill-fitting denture was an obvious cause of loss of vertical dimension within the joint. Only four patients wore their dentures throughout the 24-hour day. Of the 17 cases without dentures of any type there were 4 with obvious malocclusion of the natural teeth. In 13 patients molar teeth were absent in varying numbers.

RESULTS OF TREATMENT

The results of treatment in this series do not lend themselves to statistical accounting. The results fall into several groups. The number of cases in each group is so small that the clinical implications are lost. The psychosomatic relationship is apparent in many of the following selected case reports. Some demonstrate the difficulties of evaluating the psychosomatic factor. Others indicate the apparent absence of any psychosomatic factors.

REPORT OF CASES

E. S., a 50-year-old spinster, had pain in and about the left ear for five weeks. She had tenderness on palpation of the joint area externally and from the auditory canal when the joint was in motion. She had sustained extensive loss of molar support 10 years perviously without subsequent replacement, and there was malocclusion of the remaining teeth. Her dental condition could be considered typical for the development of the mandibular joint syndrome. She had initial insomnia, worried unduly, was frequently tense, and considered herself a nervous person. Four years later she reported that the sedative § prescribed had given relief within a few days and that the symptoms had not recurred. She had not obtained the dental treatment originally recommended.

§ The sedative used in these cases contained belladonna tincture (0.5), potassium bromide (0.5), and phenobarbital (0.015).

M. F., a 23-year-old unmarried woman, had pain alternating between the right and left ears for six months. She had tenderness on palpation of the mandibular joints in all six of the usual methods of examination. She had initial insomnia, dreamed, and had nightmares frequently and, according to her mother, had objective signs of disturbed sleep. The mandibular joint pain was present on arising in the morning and gradually wore off during the day. This relief occurred despite the fact that she developed anxiety and nervous tension and suffered from occipital and frontal headaches frequently during the working day. Two years later she reported that her discomfort had disappeared within a few days after using the sedative. The symptoms had recurred several times during the ensuing year, but relief had followed use of the sedative for about a week. She had married a year prior to the interview for this survey. Interrogation revealed a considerable subsidence of the neurotic symptoms. She also reported that the recurrent periauricular discomfort was milder and less frequent and that she had used the sedative only once during the previous year. Her dentist reported that he was not inclined to attempt any adjustment in her maloccluding but otherwise healthy teeth.

E. L. M., a 39-year-old housewife, had pain of two months' duration in the right temporomandibular joint area, radiating infra-auricularly. She had a slight overbite, but the occlusion was considered to be reasonably satisfactory. There was no obvious reason for dental referral. The onset of symptoms coincided with her return from the hospital with a new baby and the further burden of moving a rather extensive household into a new home. Two years later she reported that she was relieved within a week after use of the prescribed sedative but continued to take it for three weeks because of other benefits. There had been no recurrence of symptoms during the ensuing two years.

R. C., a 60-year-old housewife, had pain in and about the left ear for two months. Examination revealed tenderness of the mandibular joint areas, bilaterally, in all postures of examination. She had partial dentures, in poor occlusion. Interrogation revealed secondary insomnia, frequent headaches of the tension type, and mild anxiety. She reported a year later that she had been partially relieved by the prescribed sedative and that in minor recurrences sedatives had given partial relief. This patient felt that her condition was improved and attributed the improvement to an understanding of her condition, stating that she had ceased to worry about it. She had not obtained the dental treatment originally recommended.

S. S., a 42-year-old housewife, had severe pain in the right temporomandibular joint area for several months. The pain was present on awakening

in the morning. Similar pain, but less severe, sometimes occurred during the day. She also complained of a sensation of aural obstruction on the involved side, soreness on both sides of the pharynx, and a feeling of tightness in the throat. Examination showed tenderness of the preauricular joint area, with the jaw in motion, on the side of complaint. She had extensive loss of molar support on the side of complaint. Further questioning revealed secondary insomnia and frequent nightmares. She considered herself to be a tense and nervous person. Eighteen months later she reported that the prescribed sedative had brought relief within one week. She took the sedative for two weeks, as instructed. She had experienced minor recurrences of aural discomfort, but these subsided quickly without treatment. There had been no recurrence of the associated symptoms. When questioned as to tension and nervousness she stated that her family situation had improved and she had been less nervous during the past year.

S. L., a 31-year-old housewife, had left temporomandibular joint pain intermittently for three months. Her discomfort always developed late in the day. She was especially annoyed by an intermittent sensation of stuffiness in the ear on the same side. Examination revealed tenderness on palpation of the temporomandibular joint area, with the joint in motion, in the preauricular area and in the auditory vestibule. She had marked malocclusion of otherwise excellent teeth, with a shift of the jaw to the left. She said that she slept well and never had nightmares but frequently had headaches of the tension type. She stated that she became tense during the day when she cared for her two children and her home. She admitted being an obsessive perfectionist in these duties. Nineteen months later she reported that all her symptoms had been relieved by the use of the prescribed sedative for one week. She had had recurrence of symptoms several times since, and the use of the sedative had brought relief each time. She had consulted the dentist, as advised, but he did not recommend readjustment of the maloccluding but otherwise normal teeth.

D. T., a 50-year-old housewife, complained of intermittent right preauricular pain for more than 10 years. She had, in addition, marked sensation of aural obstruction with intermittent low-tone tinnitus. The pain and associated symptoms always came late in the day. She had tenderness on palpation of the right mandibular joint area externally, with the jaw closed and with the jaw in motion. There was absence of molar support on the side of complaint, without replacement. Inflation of the right Eustachian tube revealed normal patency. In the first interview she revealed a good insight into the causes of her anxiety and nervous tension. She said that she tried to maintain control by relaxing in various ways and that she usually slept well and did not dream. She voluntarily disclosed that her symptoms had been markedly aggravated during a period when she had the care of an 83-year-old incontinent father in addition to her other household duties. Four months later she reported that relief of symptoms followed use of the sedative prescribed for her and that she had used the sedative again during three recurrences. She volunteered the information that the symptoms appeared during periods of nervous tension and that by attempting to relax she was able to shorten the periods of discomfort and on several occasions do without the sedative. The advice to obtain dental treatment had not been followed.

G. S., a 59-year-old public official, complained of right preauricular and postauricular discomfort of considerable intensity for six months preceding his first visit. He had intermittent humming tinnitus, intermittent sensation of aural obstruction on the same side (relieved by opening the jaws), and tenderness of the joint area externally with the mandible in motion. He had partial loss of molar support on the side of complaint, but the remaining teeth appeared adequate to maintain a normal vertical dimension within the joint. Interrogation revealed the absence of any noticeable neurotic symptoms. Three years later he reported that relief of symptoms followed use of the prescribed sedative. He had used the sedative intermittently for six months, but during the next two and one-half years had experienced no recurrence of symptoms. He had not obtained the dental replacements originally advised. Despite the lack of any symptoms of nervous tension during the original visit, interrogation during the review visit revealed that the disappearance of his symptoms was related chronologically to an easing of stress in the public office which he held.

C. S., a 41-year-old woman, had right preauricular pain, radiating about the entire ear, for 12 years. Tinnitus and a sensation of aural obstruction often accompanied the pain. She had frequent headaches of the tension type, considered herself a nervous person, and revealed many symptoms of nervous tension. Examination revealed tenderness of the mandibular joint area, with the mandible in motion, on the side of complaint. Dental examination showed a marked overbite, but the teeth were otherwise normal. Her dentist was not inclined to attempt any correction of her malocclusion. Two and one-half years later she reported that relief of symptoms followed use of the sedative prescribed. She had taken it intermittently for approximately five months, but had not taken it for two years preceding the review visit. Recurrence of symptoms had become less severe and less frequent and usually lasted less than 12 hours. She reported that there had been a subsidence of her nervous symp-

toms since her children had reached an age where they required less supervision.

J. K., a 44-year-old woman, had left mandibular joint pain, radiating into the throat, for several months. The pharyngeal discomfort was of an aching and pulling nature. She had, in addition, burning discomfort of the mouth and tongue on the same side. She had symptoms of mild anxiety and nervous tension and considered herself a nervous person. There was marked tenderness of the mandibular joint on the side of complaint, in all postures of examination. Dental examination revealed complete loss of molar support on the side of complaint. Two years later she reported that the mandibular joint pain disappeared during the three weeks in which she used the prescribed sedative. There had been no recurrence. The pharyngeal symptoms and the burning discomfort of the mouth and tongue had not been relieved by the sedative and had persisted up to the time of the review examination. She had not obtained the dental care originally recommended.

W. W. K., a 71-year-old woman, experienced bilateral intermittent mandibular joint pain for three months. Symptoms of anxiety and nervous tension had been present for many years. Palpation of the mandibular joint areas by any of the usual methods failed to reveal any marked tenderness. She had complete dentures that fitted reasonably well. Her symptoms developed during a period when she anticipated cataract extraction with considerable dread. Review two years later indicated that she had obtained relief of her symptoms during use of the prescribed sedative. When discomfort recurred she used the 2.0 mm. cork discs given her. She obtained relief when these were worn on each side posteriorly. She reported that she vacillated between use of these two measures for relief of her symptoms. After cataract extraction and restoration of vision the symptoms disappeared, and they had not recurred during the one and one-half years preceding the review visit. She refused to have new dental plates unless the symptoms recurred.

E. D. N., a 29-year-old woman, had intermittent left mandibular joint pain for several months. This patient was extremely neurotic. She had tenderness on palpation of the joint on the side of complaint, both externally and in the auditory vestibule, with the mandible in motion. Dental examination revealed extensive loss of molar support on the side of complaint. During review a year and a half later, she reported relief of symptoms while using the sedative prescribed. She used it intermittently for three months for minor recurrence of symptoms and other benefits. She had not consulted a neuropsychiatrist, as advised, nor had she consulted a dentist, as recommended. She reported many minor recurrences and one severe recurrence of symptoms while entertaining guests at home. Her conversation during the review examination indicated a definite persecution complex, not noted during the original examination.

The preceding selected case reports tend to demonstrate a psychosomatic relationship in temporomandibular joint disturbance. The following cases tend to indicate the fallacy of overemphasis of the psychosomatic factor. They also indicate the necessity for correction of the mechanical or dental condition inducing the temporomandibular joint syndrome if treatment is to be successful.

J. K., a 53-year-old man, had moderately severe pain in the right preauricular area, radiating behind the ear, for four days. Tenderness on palpation of the right temporomandibular joint externally, with the jaw in motion, was present. Dental examination revealed extensive loss of molar teeth. On the side of complaint the vertical dimension was maintained by an isolated right lower second molar. This patient had been treated for a number of other complaints previously and was known to have a mild anxiety neurosis. He considered himself a nervous person. Three years later, during the review, he reported that the sedative prescribed had relieved him within a few days and he stopped taking it after one week. Three weeks later, when the symptom recurred, he consulted the dentist, as originally advised. The dentist told him that his teeth and occlusion were satisfactory but asked him to consider application of partial dentures for improvement of masticatory function. Several days later a gold crown came off the isolated right lower second molar and the dentist replaced it. The patient reported that his symptoms disappeared within 24 hours after this dental procedure and did not return during the ensuing three years. He also stated that it was several weeks before he attained comfortable dental occlusion.

C. S., a 55-year-old housewife, had severe discomfort in the left preauricular area for several months. The pain always came during the day. Tenderness of the involved joint was not revealed by any of the methods of examination. She had 14-year-old ill-fitting complete dentures. She had initial insomnia, dreamed occasionally, and had frequent bitemporal headaches. The sedative prescribed for her failed to give any relief during the week that she used it. Salicylates combined with the sedative brought a measure of relief after their use for one week. She was completely relieved by wearing cork discs and, later, folded paper between the posterior teeth for three weeks. During the review visit she reported that there had been no recurrence of symptoms during the preceding

year and a half. She was still wearing the old, ill-fitting dentures.

G. S., a 57-year-old woman, complained of pain in the right preauricular area for several months. Examination revealed tenderness on palpation of the right temporomandibular joint area externally, with the jaw in motion. Malocclusion of her complete dentures was obvious. She complained of insomnia, dreamed occasionally, and had symptoms of mild nervous tension. Two and one-half years later she reported that she had obtained no relief from the prescribed sedative. She finally consulted the dentist, as advised. She stated that the dentist ground off some of the posterior extension of the dentures and ground down the anterior denture teeth. The discomfort disappeared within a few days after this adjustment. The pain recurred several months later, and further adjustment of the dentures brought relief of symptoms within a few days. She reported that there had been no reccurrence of symptoms during the two years preceding the review visit.

R. F., a 38-year-old physician, complained of mandibular joint pain on the left side of several months' duration. When the discomfort began to interfere with the eating of two favorite foods, corn-on-the-cob and apples, he sought medical advice. An intense person, possessed of driving energy, he was an inveterate pipe smoker and clutched the pipestem in the teeth, on the right side, with such force that he wore pipe bits out in a short time. He had excellent teeth in good occlusion. A year later he reported that cessation of pipe smoking resulted in rapid amelioration of his symptoms. Two months elapsed before he was completely comfortable.

These 16 cases exemplify the experience with this group. The unreported cases of the series fall into a pattern similar to one of the selected group.

Sedatives were given a trial in 24 of the 26 cases. Twenty patients reported relief of symptoms while taking sedatives. In 12 cases there was recurrence of symptoms which subsided spontaneously without any treatment. In six cases recurrent symptoms were relieved when use of the sedative was resumed. Twenty-three of the 24 patients for whom sedatives were prescribed were referred for dental consultation. Seven obtained dental consultation and four were relieved by dental treatment. Two patients were referred for dental consultation without medical treatment of any kind. One of these obtained dental consultation and was relieved by dental treatment. Five of the eight patients who sought dental care were permanently relieved by dental treatment.

A control series using a placebo substitute for the sedative was not possible, since the material for this study came from previously treated cases. Neuropsychiatric consultation was neither readily available nor necessarily indicated for most of the patients included in this report.

COMMENT

It is difficult to evaluate the result of treatment in a disease characterized by spontaneous remission of symptoms. In a disease with extended remission periods the difficulties are aggravated. When the disease depends upon mechanical derangement, correction of the derangement permits interpretation of results on a sound basis. These considerations apply to Costen's syndrome.

When an attempt is made to interpret the psychosomatic relations of the syndrome the difficulties are multiplied. Mild neurosis occurs frequently in all types of patients. The possibility of temporomandibular joint syndrome occurring coincidentally but without relation to a neurosis is obvious. The difficulties in interpreting the tenuous symptomatology of the neurosis further tend to discourage an attempt to evaluate any relation between the disease entities.

The relation between mandibular joint pain experienced on arising and forceful occlusion of the teeth during dreaming and nightmares is intriguing. This occurred in eight cases in this series. This is an interesting contrast to the five patients who experienced initiation or aggravation of symptoms during or after meals. This would seem to indicate that with the modern, rather soft diet the teeth are occluded with a delicate nicety that does not impinge the condyle forcibly into the fossa, even when molar support for the maintenance of the vertical dimension is absent. The chewing of gum, done with great force by some persons, seems more likely to cause difficulty than eating. Five patients in this series chewed gum frequently, and two had initia-

tion or aggravation of symptoms when they did so. One patient was relieved by chewing gum.

The onset of symptoms during periods of emotional stress, and subsidence of symptoms with termination of the stress, indicates the possibility of a psychosomatic precipitating effect on the painful symptoms of the syndrome. This may be of more importance when it is realized, as Seaver [27] pointed out, that all injurious stimuli do not register as pain.

The relation between the number of persons with a dental condition conducive to the development of temporomandibular joint syndrome and the number of persons in whom the syndrome eventually develops has not been established. Clinical experience tends to indicate that the syndrome develops in a relatively small percentage of patients with typical dental conditions for inducing the syndrome. An adequate explanation for this fact has not been offered. The intermittency of symptomatology, so typical of the syndrome, also needs explanation. It appears that some agency, other than the physical situation necessary for development of the syndrome, is required to precipitate it. It seems that the psychosomatic relation deserves consideration as one of the possible precipitating factors in the development of the syndrome.

The possibility of relationship between anxiety neurosis, nervous tension, and similar conditions and the initiation of the painful symptoms of Costen's syndrome should not divert attention from the necessity for applying accepted and established therapy. Anatomic and physiologic correction of the derangement that makes injury, and therefore pain, possible should be carried out as usual. For with physical correction of the anatomic derangement the psychosomatic precipitation of painful episodes should become impossible.

SUMMARY

The literature on temporomandibular joint syndrome is reviewed, and the present concept of the disease is outlined.

The paucity of reports on psychosomatic relation to the syndrome is indicated.

A clinical review of 26 previously treated patients with temporomandibular joint disturbance is presented and analyzed.

The psychosomatic aspects of the syndrome are discussed. The possibility of a psychosomatic precipitation factor in the initiation of pain episodes in the syndrome is indicated.

The lack of control studies in this investigation is admitted.

The necessity for adherence to established treatment is stressed.

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Cancer of the Larynx

Report of a Case in a Negro Woman Nineteen Years of Age

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According to Jackson and Jackson,[1] statistics show that malignant disease of the larynx is uncommon before 25 years of age. Most of the cases occur in patients over 40. However, they state that it has occurred in a patient 3 years of age. This, however, is an exceedingly rare exception to the rule. Their statistics showed that of 688 cases of malignant disease of the larynx 635 occurred in men (92.3%) and 53 (7.7%) were in women.

Walsh and Beamer [2] reported two cases of epidermoid carcinoma of the larynx occurring in two children with papilloma of the larynx: a boy of 12 and a girl of 11.

Negus,[3] in reporting on a series of cases of carcinoma of the larynx (93 intrinsic and 94 extrinsic), found in his series of 93 intrinsic cases 90 men and 3 women. The youngest patient was a woman of 26 years of age.

Martin [4] reported the median age in 725 consecutive cases of laryngeal cancer admitted to the Memorial Hospital (in New York City), 1935 to 1945, inclusive, was about 60 years of age. The median age of patients with intrinsic cancer of the larynx appears to be slightly greater (one year) than that of those with extrinsic cancer. In the female extrinsic cancer occurs at about the same age as in the male, but the median age of intrinsic cancer in female patients is greater (five years), although the youngest patient in that series was a female patient, aged 25.

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From the Division of Otolaryngology, Jewish Hospital, Service of Dr. Samuel Weinstein.

Orton [5] reported a case of carcinoma of the larynx in a child 13½ years old. He said carcinoma of the larynx occurring in the second decade of life is rare, and this, in itself, is of sufficient importance to warrant the reporting of such a case.

LeJeune and Lynch,[6] in reviewing 537 cases of cancer of the larynx, say the majority of patients with carcinoma of the larynx are middle-aged men. Only 8% of the patients with carcinoma of the larynx were females. This is only slightly lower than the incidence of 10%-15% usually reported by most authors.

The average age of the patients having a laryngectomy was 56.6 years. The youngest patient was 20 years old.

There were several Negro men in their series, but they do not personally recall ever having seen a Negro woman with carcinoma of the larynx.

The following is the report of a case of intrinsic carcinoma of the larynx occurring in a Negro woman 19 years of age.

REPORT OF CASE

M. A., 19 years of age, female, Negro, single, was admitted to the medical service of the Jewish Hospital on June 28, 1954, with a history of cough and sore throat for two months. Two months previous to admission she had a sore throat, which was treated by her local physician, who gave her some green pills. About a week later the sore throat had progressed to the point where the patient lost her voice, and this persisted to the time of admission. She had a mild, nonproductive cough, no temperature elevation, had pain in eating solid foods, and she would drink liquids if they were not too cold.

Two days previous to admission the patient had chest pain, aggravated by deep breathing, first only at night, but since the day before admission also in the daytime.

Her past and family histories were irrelevant. The positive findings on admission were tempera-

ture, 100 F; pulse, 84; blood pressure, 110/50. The pharynx and tonsils appeared somewhat edematous and injected, speaking was difficult and apparently painful, the voice was high-pitched and rasping, and there was noisy breathing suggestive of some laryngeal obstruction. There were a few lymph nodes located anteriorly in the neck which were tender. Chest examination showed some decreased movement on the left and a few crepitant rales at the left base. The impression of the medical service was that this might be a viral pneumonitis or a laryngotracheobronchitis.

On June 30, 1954, because the patient was wheezing and she seemed to be having some respiratory difficulty, the ear, nose, and throat service was called into emergency consultation. The patient was found to be alert and cooperative, and although an inspiratory wheeze was heard, there did not seem to be any real respiratory distress. Examination of the mouth revealed that the gums, teeth, and oral mucosa were negative. The tonsils were moderately large but not unusual.

On indirect laryngoscopy the epiglottis and valleculae were negative. The interior of the larynx was the seat of marked pathology. There was edema of the left arytenoid, and there was a grayish-white slough on the left side of the larynx occupying the false cord, ventricle, and true cord and filling most of the glottis, leaving very little breathing space. The impression was that the left side of the larynx was fixed, although at times there seemed to be a little motion in the left arytenoid. No lesion was seen on the right side.

The airway at this examination seemed to be adequate but precarious. The possibilities considered at this time were a Koch infection, syphilis, neoplasm, diphtheria, or a lesion associated with a blood dyscrasia.

Smear and cultures were taken by indirect laryngoscopy, and large doses of antibiotics were advised. The medical service was advised that tracheotomy might be necessary, and the advisability of direct laryngoscopy and biopsy was suggested.

On July 1, 1954, the next day, the patient had become more dyspneic. She was taken to the operating room for direct laryngoscopy. The larynx showed marked edema and slough of the left aryepiglottic fold, false cord, and ventricle, with a large amount of bloody exudate. It was impossible to completely visualize an airway, as the true cord and glottic chink were covered by this slough.

Because of this fact and because of increasing dyspnea during the examination, it was deemed necessary to establish an airway before anything else at this time. A bronchoscope was therefore passed, and a tracheotomy was performed. A culture had been taken, but the diagnosis was deferred until subsequent laryngoscopy and biopsy. The patient was then transferred to the ear, nose, and throat service.

On July 2, 1954, we received a report from the medical service that the Pirquet test which they had performed was negative. I should also mention here that x-rays of the chest were taken on June 30, 1954, and the report was as follows: "There is no evidence of pulmonary or apical pathology. An incident finding is the presence of an anomalous rib in the right upper chest. The heart and the aortic shadows are normal. Diagnosis: Negative Chest."

The patient was taken to the operating room again, on July 6, 1954, for direct laryngoscopy and biopsy. At this time the left arytenoid was somewhat edematous. The interior of the larynx on the left side was filled with a granulomatous mass covered with slough, and this bled very easily. A number of pieces were taken for biopsy. Also, smears and culture were taken for bacteriology.

A Schick test done on July 6, 1954, was reported negative the next day.

On July 8, 1954, the pathology laboratory reported that the biopsy specimen taken by direct laryngoscopy showed squamous-cell carcinoma.

For the next two days the patient complained of abdominal pain and cough. She was seen by a medical consultant, who found nothing specific, and by July 11, 1954, all complaints had disappeared.

Blood chemistry studies were normal, the blood cell count and urinalysis were normal, and the patient's blood type was Group A, Rh-positive. The Mazzini test was negative. On July 12, 1954, she had a dental check-up and no pathology was found. The laryngeal smear and culture taken on June 30, 1954, was reported as follows: Gram-positive cocci. No C. diphtheria seen. The culture was reported as follows: Staphylococcus aureus, Streptococcus of the viridans group, and Aerobacter aerogenes. The subsequent laryngeal smears were reported as follows:

Gram stain: Pus cells and R. B. C. Gram-positive cocci; Gram-negative bacilli.

Albert stain: No diphtheria bacilli seen.

Vincent's stain: No Vincent's organisms.

TBC: No acid-fast bacilli seen.

The electrocardiogram, taken July 8, 1954, showed nothing of significance.

It should be mentioned that by this time the few small tender lymph nodes in the center of the neck had completely disappeared under antibiotic therapy. The patient was taken to the operating room on July 15, 1954, and a wide-field complete laryngectomy was performed under general anesthesia. Transfusion was started at the beginning of the operation. She was given a total of 1000 cc. of blood.

Pathology report after laryngectomy: Gross specimen consisted of a larynx resected below the

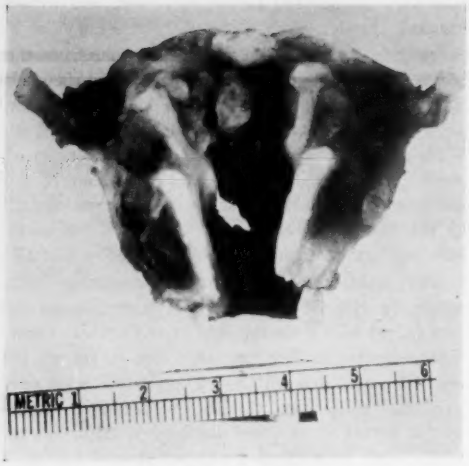


Fig. 1.—Larynx—gross specimen.

first ring of the trachea. The inlet of the larynx was partially obstructed by a tumoral mass, and surrounding the thyroid cartilage was a small amount of tan-brown tissue. On opening the larynx the tumor mass measured about 3 cm. in diameter and replaced most of the laryngeal tissues on the left side for the most part, and remnants of vocal cord were seen in the posterior aspect. The tumor mass consisted of tan-brown yellowish and somewhat friable tissues. On cut section of the tumor mass it measured 1.2 cm. in thickness and was seen infiltrating around the collagenous tissue except around the outer aspect.

Three sections were taken for study and labeled B.

Accompanying the specimen was an epiglottis measuring 2 by 2 cm. One surface was tan-gray yellow and smooth, and the other was roughened by granular tan-brown yellowish tissue.

Two sections were taken for study and labeled A.

Also accompanying the specimen were several small tan-gray and soft lymph nodes measuring up to 0.6 cm. in diameter and matted together by the usual fibrous tissues, and attached to one end was a small piece of red-brown skeletal muscle measuring 1 cm. in diameter.

Entire specimen was taken for study and labeled C.

Microscopic examination: Preparation marked A from the epiglottis showed the circumference covered by stratified squamous epithelium. The subjacent tissue was loose, and in the deeper portions there were mucous and serous glands and cartilage. No tumor was present in this section.

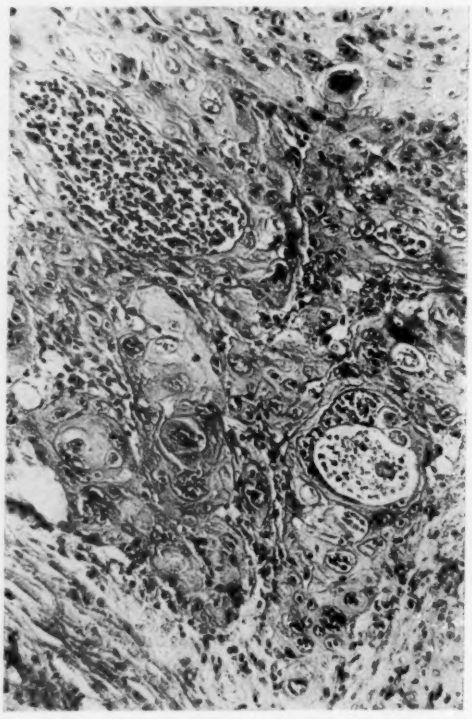
Preparation marked B showed tumor, and this consisted of large irregular polygonal cells of varying size and nuclear staining. In many the nuclei were large, irregular, and hyperchromatic. There was extensive keratinization with many pearly formations. In some areas the tumor was seen arising from overlying mucosa. Cartilage, mucous and serous glands were noted in the deeper portion.

Preparation marked C showed a small lymph node at one end, which was the seat of a lymphadenitis, with some areas of necrosis. There was, however, no tumor present here. Other fragments consisted of bundles of striped muscle and adipose tissue and of thyroid-gland acini filled with colloid. These were lined by cuboidal cells. Within there was one structure which was poorly defined but resembled an encapsulated parasite.

Diagnosis: Larynx and epiglottis with squamous-cell carcinoma, well differentiated. Lymph nodes with lymphnodulitis and with necrosis. Portion of thyroid gland and striped muscle with suspicious encapsulated parasite.

The patient did quite well after the operation. On July 20, 1954, some odor was noticed in the wound and some slough was present in the upper part of the vertical incision. The sutures were removed at this time from the horizontal and vertical incisions but were left in around the tracheal stump.

Fig. 2.—Photomicrograph of section from the larynx showing squamous-cell carcinoma.



The dressing above the tracheotomy tube was kept wet with surgical solution of chlorinated soda (Dakin's solution).

The next day all sutures were removed from the tracheal stump, the Levin tube was removed, and the patient was allowed to swallow water colored with methylene blue. There was no leakage.

By July 23, 1954, we received a report on the smear and culture taken from the wound. It was Proteus vulgaris. The patient, who had been on penicillin, was now put on chloramphenicol (Chloromycetin). From then on the course was very satisfactory; the temperature, which had been up to 103.8 F, came down to normal by July 27, 1954, and on July 28, 1954, the patient was put on a full diet and the chloramphenicol discontinued. The wound granulated in nicely, and the patient was discharged to the outpatient department on Aug. 7, 1954. I should mention that after the P. vulgaris culture was obtained the Dakin's solution dressing to the wound was discontinued and an ointment containing bacitracin and polymyxin was used.

The patient was followed in the outpatient department, and on Oct. 20, 1954, the lumen of the tracheal stump being considered very adequate, it was decided to remove the tracheotomy tube. The patient was given a tracheotomy tube to take home to be reinserted in case of necessity. Shortly after she arrived home she became very dyspneic, and she rushed back to the emergency room of the hospital, where she was given oxygen under pressure and a tracheotomy tube reinserted.

At times the patient coughed up some blood subsequent to this episode, but medical consultation and x-ray studies revealed no evidence of pathology or metastasis. On Dec. 9, 1954, she was admitted to the hospital for bronchoscopy. Several areas of mucosal traumatization were seen on the posterior tracheal wall and just below the orifice of the left main bronchus. There was no evidence of recurrence and no granuloma.

It was decided that this traumatization was a result of the tube changes and that perhaps the No. 8 tube she was wearing was too large. Two No. 6 short tubes were especially made for her, and she now gets along very well, without any trouble.

I believe that the patient could get along without a tube, but she just will not hear of it. It was my impression that the episode of dyspnea following removal of the tube on Oct. 20, 1954, was due to spasm on a psychological basis. The patient just fears the idea of having the tube removed.

A good deal of keloid developed in the scar, and on Jan. 20, 1955, she was admitted to the plastic surgery service of the hospital for correction of this condition, and she was given x-ray therapy subsequently. However, there has been some recurrence of the keloid.

To date there has been no evidence of recurrence of the lesion or metastasis, and the patient is quite comfortable.

I might add that the patient was sent to the National Hospital for Speech Disorders for instruction in esophageal speech, but, for some unexplainable reason, she did not persist and does not seem to be interested.

When seen in the clinic she certainly does not have a good voice, but her mother tells me that at home she can talk pretty well when she wants to.

SUMMARY

A case of intrinsic laryngeal carcinoma in a 19-year-old Negro woman is reported because laryngeal carcinoma in the second decade of life is quite rare in all series and laryngeal carcinoma in a Negro female is extremely rare at any time.

441 Ocean Ave. (26).

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Antibiotic Specificity in Ear, Nose, and Throat Infections

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Since the introduction by Duggar of chlortetracycline (Aureomycin) in 1948 and the subsequent search for and discovery of other antibiotics, an enormous amount of work has been done by clinicians and bacteriologists on antibiotic specificity. Selection of a suitable antibiotic in treating infections of the ears and sinuses during World War II was simple. Near the front lines only the sulfonamides were available for use. The sulfonamides were widely used locally and systemically, with good results. In the nine years following the war, approximately 45,000 veterans were seen at the ENT Clinic of the New York Regional Office of the Veterans Administration. Most of the chronic infections encountered at this time proved to be resistant to the sulfonamides and to penicillin.

It became imperative to study the bacterial flora in the veteran population and find what antibiotic to use in each individual case. The patients studied were veterans of the Spanish-American War, World War I, World War II, and the Korean War. Their ages ranged from 18 to 75 years. Some of these infections had persisted for 30 years.

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From the Ear, Nose and Throat Clinic, New York Regional Office, Veterans Administration.

A Research Project of the E.N.T.-Audiology Clinic of the New York Regional Office of the Veterans Administration.

PROCEDURE

Routine cultures or sensitivity tests of purulent exudate from the ears, nose, and throat or both were made of all cases studied since January, 1954. Using the methods advocated by Goldman, a sterile cotton applicator or a sterile platinum loop was used for obtaining exudate for culture. The material obtained from the patient was inoculated into a test tube containing Bacto-Agar and fluid thioglycollate medium (Difco) (final pH 7.1). The inoculated culture was immediately placed in an Elko Knapp incubator and maintained at 37.5 C for 24 hours; then a sample of the culture was smeared on a glass slide and appropriately stained. It was then subcultured on suitable media to identify the organism. The inoculated broth was then streaked across the surface of a blood-agar plate and the Difco sensitivity discs of 10 different antibiotics were placed on the plate, and the plate was incubated again for 24 hours. A clear zone of nongrowth surrounding the disc was interpreted as indicating sensitivity. We differentiate the pathogenic staphylococci from the saprophytic staphylococci by the coagulase test. Fresh human or rabbit serum is coagulated only by the pathogens.

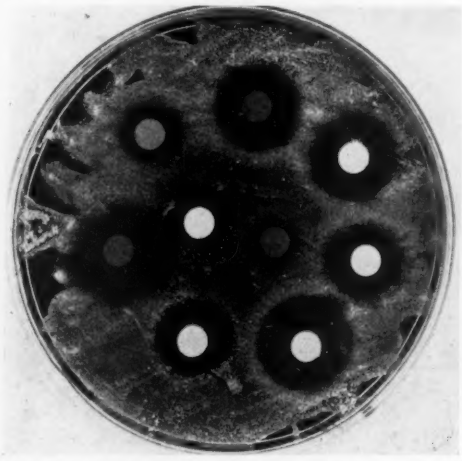
THE RESULTS OF IN VITRO TESTS

The results as condensed in the tables reveal that hemolytic Staphylococcus aureus, coagulase-positive, is numerically the most commonly encountered pathogen in both ears and sinuses. The next most commonly encountered pathogen is Proteus vulgaris. Pseudomonas aeruginosa, while third, is a very close contestant. It is interesting to note the findings of an investigative group in Punjab, India. In a totally different geographic locale, thousands of miles away from New York City, this group finds the same three common pathogenic organisms in ear, nose, and throat infections. The total absence of Streptococcus infections in our study

during the past year was a revelation. We must consider the fact that most of these infections were chronic. An explanation of this phenomenon may be found in a recent book edited by Dubos. This reference explains that the specific type of streptococcal antibodies is absent in the blood of young children, while its existence in that of adolescents and adults suggests that these antibodies may have arisen from repeated streptococcal infections. All of the patients reported upon in this paper were adults. In addition, it seems an inescapable conclusion that the sulfonamides and penicillin have been extraordinarily successful in combating infections caused by strains of streptococci.

The problem of coping with infections caused by resistant strains of hemolytic S. aureus is a formidable one. Over 50% of the strains of hemolytic S. aureus studied in vitro showed resistance to penicillin. Seventy-three per cent of the P. vulgaris strains were resistant to penicillin. One hundred per cent of the P. aeruginosa strains were resistant to penicillin. Our cultures showed some pathogens other than the three most commonly encountered mentioned above. These were five strains of nonhemolytic S. aureus, four strains of E. coli, two strains of N. flava, and two strains of D. pneumoniae.

Fig. 1.—Culture of hemolytic Staphylococcus aureus from a case of purulent sinusitis showing resistance to polymyxin and sensitivity to all other antibiotics.



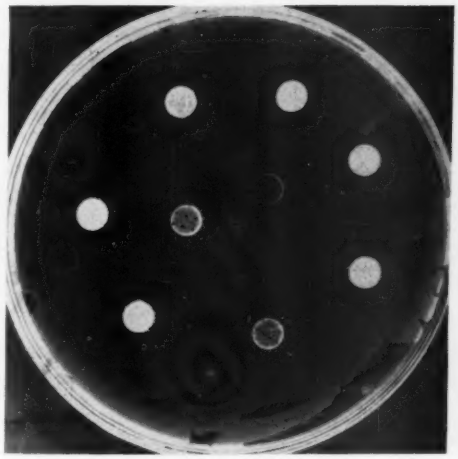


Fig. 2.—Culture of Pseudomonas aeruginosa from a case of OMPC showing resistance to all antibiotics except polymyxin.

Of the specimens taken from patients 95% proved to be pure cultures; the remaining 5% of cases were mixed infections.

CLINICAL PROCEDURES

In common with the current thinking of otolaryngology, it is considered that the organisms here reported on in these chronic infections were not the original bacteria causing the otitis media. It is presumed that the invasive process of the original pathogens had been halted by the defense mechanisms of the host and/or with the aid of penicillin and sulfonamides given at the time of the original acute infection. The chronic infections are due to secondary invaders. Hansel believes that so far the pneumococci and Group A hemolytic streptococci organisms show no evidence of developing resistance to the available antibiotics. Though culture of our cases of chronic otitis media showed neither of these organisms, we suspect from our years of experience in the preantibiotic era that they contributed heavily to the ear pathology originally. These ears with chronic otitis media showed perforations of the drums, adhesions of the middle-ear ossicles, and sclerotic mastoids. A conjectural point, which is not made clear in any current literature dealing with this subject, is the amount of

TABLE 1.—*In Vitro Tests of Pseudomonas Aeruginosa*

	Group 1 (Bactericidal)						Group 2 (Bacteriostatic)			
	Penicillin	Streptomycin	Erythromycin	Bacitracin	Neomycin	Polymyxin	Chlortetracycline	Chloramphenicol	Oxytetracycline	Tetracycline
1. OMPA	..	..	..	..	..	..	..	..	..	..
2. OMPC	..	..	..	..	X	..	..	..	..	..
3. OMPC	..	..	..	..	X	..	..	..	..	..
4. OMPC	..	..	..	..	X	..	..	..	..	..
5. OMPC	..	..	..	..	..	X	..	..	..	..
6. OMPC	..	..	..	..	..	X	..	..	..	..
7. External otitis	..	..	..	..	..	X	..	..	..	..
8. OMPC	..	..	..	..	..	X	..	..	..	X
9. OMPC	..	..	..	..	..	X	..	X	..	..
10. OMPC	..	..	..	..	..	..	..	X	..	..
11. OMPC	..	..	..	..	..	..	..	X	..	..
12. External otitis	..	..	..	..	..	..	..	X	..	..
13. External otitis	..	..	..	..	..	..	..	X	..	..
14. OMPC	..	X	..	..	..	..	..	X	..	..
15. Sinusitis	..	..	..	..	X	..	X	X	X	..
16. OMPC	..	..	..	..	..	..	..	..	X	..
17. External otitis	..	X	..	..	..	..	..	..	..	..
Total sensitive strains	0	2	0	0	4	5	1	7	2	1

pathology caused by the long-dwelling secondary invaders. Of the 65 cases of acute and chronic otitis media studied, 4 were postfenestration suppurating cavities. Routine x-rays of the mastoid showed sclerotic changes in most of the chronically infected ears.

The ears of the patients seen were thoroughly cleaned of wax, purulent exudate, and other debris by irrigation with warm sterile saline solution and dried with sterile cotton wipes. Granulations were cauterized with 75% silver nitrate. The specific antibiotic selected by sensitivity tests in each particular patient was blown into the ear with a powder insufflator. An effort was made to get some of the powder through any existing perforation. This treatment was

TABLE 2.—*In Vitro Tests of Proteus Vulgaris in External and Otitis Media*

	Group 1 (Bactericidal)						Group 2 (Bacteriostatic)			
	Penicillin	Streptomycin	Erythromycin	Bacitracin	Neomycin	Polymyxin	Chlortetracycline	Chloramphenicol	Oxytetracycline	Tetracycline
1.	..	..	..	..	..	..	..	X	..	..
2.	..	X	..	..	..	..	X	X	X	X
3.	..	..	..	..	..	..	X	X	..	X
4.	..	X	..	..	..	..	X	X	X	..
5.	..	..	..	..	X	..	..	X	..	..
6.	..	X	X	..	..	..	X	X	X	..
7.	..	..	..	..	..	..	..	X	..	..
8.	..	..	..	..	..	..	..	X	..	..
9.	..	..	..	..	X	..	X	X	X	X
10.	..	X	..	..	..	..	..	X	..	..
11.	..	X	..	..	..	..	..	X	X	X
12.	X	..	..	..	X	..	..	X	..	..
13.	X	..	..	..	..	..	..	X	..	..
14.	..	..	..	..	..	X	..	X	..	..
15.	X	..	X	..	..	X	..	X	..	..
16.	..	..	..	..	X	..	X	X	..	X
17.	X	..	..	..	..	..	..	X	..	..
18.	X	..	..	..	..	..	..	X	..	..
19.	X	..	..	..	..	..	..	X	..	..
20.	..	..	X	X	..	..	..	X	X	X
21.	..	X	..	..	..	..	..	X	..	..
22.	..	..	..	..	X	..	X	X	..	..
23.	..	..	..	..	X	X	..	..	..	..
24.	..	..	..	..	..	X	..	..	..	..
25.	..	..	X	..	..	..	X	..	..	X
Total sensitive strains	6	6	4	1	6	4	8	22	6	7

TABLE 3.—*In Vitro Tests of Hemolytic Staphylococcus Aureus in External and Otitis Media*

	Group 1 (Bactericidal)						Group 2 (Bacteriostatic)			
	Penicillin	Streptomycin	Erythromycin	Bacitracin	Neomycin	Polymyxin	Chlortetracycline	Chloramphenicol	Oxytetracycline	Tetracycline
1. OMPC	X	..	X	..	X	..	X	X	X	X
2. OMPC	X	..	X	X	X	..	X	X	X	X
3. OMPC	X	..	X	X	X	..	..	X	..	..
4. OMPC	X	X	..	X	X	X	X	..	X	..
5. OMPC	X	..	X	X	..	..	..	X	..	..
6. OMPC	..	..	X	X	X	..	..	..	..	..
7. OMPC	..	..	..	X	X	X	..	..	..	..
8. OMPC	..	..	..	X	X	..	..	..	..	..
9. OMPC	..	X	X	..	X	..	X	X	..	..
10. OMPC	..	..	X	..	X	..	X	..	..	X
11. OMPC	..	X	X	..	X	..	X	X	..	X
12. OMPC	..	X	..	..	X	..	X	X	X	X
13. OMPA	..	..	..	..	X	..	..	X	..	..
14. OMPA	..	..	X	X	X	..	..	X	..	..
15. OMPA	..	..	X	X	..	..	..	X	X	X
16. OMPA	..	X	X	..	..	..	X	..	X	X
17. External otitis	..	X	X	..	X	X	X	X	X	X
18. External otitis	X	..	X	X	X	..	..	X	..	..
19. External otitis	..	..	..	..	..	..	..	X	..	..
20. External otitis	..	..	..	..	X	..	X	X	X	..
21. External otitis	X	..	X	X	X	..	X	X	X	X
22. External otitis	..	..	X	X	X	..	..	..	..	..
23. External otitis	X	..	X	X	..	..	X	X	X	X
24. External otitis	..	..	X	X	X	X	..	X	..	..
Total sensitive strains	8	6	17	14	19	4	12	17	10	10

repeated twice a week until the ear was dry. All the antibiotics except penicillin were kept in DeVilbis powder blowers. Because of the increasing number of instances of sensitization to penicillin, the Council on Pharmacy and Chemistry of the American Medical Association was no longer accepting any penicillin preparation designed for local therapy or topical application at the time that it terminated its acceptance program. In conformity with this policy, penicillin was not given locally in any topical application. We found, just as Hearn did, that chloramphenicol (Chloromycetin) was the

TABLE 4.—*In Vitro Tests of Hemolytic Staphylococcus Aureus in Sinusitis*

	Group 1 (Bactericidal)						Group 2 (Bacteriostatic)			
	Penicillin	Streptomycin	Erythromycin	Bacitracin	Neomycin	Polymyxin	Chlortetracycline	Chloramphenicol	Oxytetracycline	Tetracycline
1.	X	..	X	X	X	..	X	X	X	X
2.	X	..	X	X	..	..	X	X	X	X
3.	X	..	X	X	..	..	X	X	X	X
4.	X	..	X	..	..	..	X	X	X	X
5.	..	X	..	..	X	X	X	X	X	X
6.	..	..	X	..	..	..	X	X	X	X
7.	..	..	X	..	..	..	X	X	X	X
8.	..	..	X	..	X	X	X	X	X	X
9.	X	..	..	X	..	..	X	..	X	X
10.	X	..	X	..	X	..	X	X	X	..
11.	X	X	..	X	..	..	..	X	..	..
12.	X	..	..	X	X	X	..	..	X	..
13.	X	..	X	..	X	..	..	..	..	..
14.	..	..	X	..	X	..	..	X	..	..
15.	..	..	X	..	..	..	..	X	..	..
16.	..	..	X	X	X	..	..	X	..	..
17.	X	..	X	X	..	..	X	X	X	X
18.	X	..	..	X	..	..	X	X	X	X
19.	..	X	X	X	X	..	X	X	X	X
20.	..	X	X	X	X	..	X	X	X	X
Total sensitive strains	11	4	15	11	10	3	14	17	15	13

drug of choice in the majority (70%) of cases with otitic infections. Bacitracin, polymyxin, and neomycin are all nephrotoxic agents. In addition, neomycin is ototoxic. We have never administered these drugs systemically. The minute amounts, approximately 20 mg. of powder, insufflated into the ear were not sufficient to cause toxicity, yet were highly concentrated in the small area to give the desired therapeutic effect.

Note in Table 1 that 75% of the strains of P. aeruginosa are only sensitive to a single antibiotic. This enteric, Gram-negative organism is principally a scavenger of necrotic material and has a relatively low capacity to invade a reasonably healthy tissue. As a consequence, in infection by Pseudomonas the removal of the necrotic material is as important as the use of the antibiotic locally.

Results of studies with P. vulgaris are shown in Table 2. This organism is an efficient parasite which lives in harmony with its host. As with all other Gram-negative bacilli, the bacteriostatic group of antibiotics are more efficient in dealing with this organism. Sometimes we administer these drugs systemically. The side-effects of these bacteriostatic drugs may be nausea, vomiting, diarrhea, and anusitis. Therefore a patient is given only a two-day supply of 16 capsules (250 mg. each). He takes two capsules every 6 hours for 48 hours. Several hours after the last dose, the patient is instructed to take a cathartic, the purpose of which is to sweep any lingering traces of the drug from the intestines and thus prevent any possible delayed development of diarrhea due to the effect of the drug on the normal bacterial flora of the bowel.

Table 3 shows the results of studies on infection of the ears with hemolytic S. aureus. This Gram-positive organism has adapted itself to a parasitic mode of existence similar to that of the two Gram-negative pathogens described above. As is well known, the Gram-positive organisms are more susceptible to the bactericidal group of antibiotics. Note that there are two types of hemolytic S. aureus strains: the invasive type, with its predatory activities still dominant, that causes severe infections, and the parasitic type, which lives in the ear canals, causing minor symptoms of itching and discharge.

The results of studies of sinusitis caused by hemolytic S. aureus are shown in Table 4. In our experience the majority of the more chronic and extremely resistant sinus infections are caused by this organism. The strains isolated in the cultures are more sensitive to penicillin and to all of the bacteriostatic group of drugs than are those found in ear infections. Bacteria can undergo hereditary variations affecting most of their characteristics, in particular those which condition pathogenicity. The occurrence and transmission of hereditary changes in bacteria often suggest the participation of a gene mechanism similar to that operating in higher cells.

To prevent mutations and the emergence of drug-resistant strains of staphylococci, such as have been reported to develop when small doses of antibiotics are used, we treat sinusitis with large doses of penicillin; 600,000 units was given daily until the discharge ceased and the sinuses were clear on x-ray and transillumination.

According to Jawetz and Gunnison, antibiotics can be appropriately grouped as follows:

Group 1 (Bactericidal) Group 2 (Bacteriostatic)

1+1 Frequently synergistic with each other, never antagonistic, occasionally indifferent.

2+2 Usually merely additive to each other, never synergistic or antagonistic.

1+2 If the S. aureus is highly sensitive to Group 1 drug, antagonism may result. If the S. aureus is highly resistant to Group 1 drug, synergism may result.

We combined penicillin with a second suitable antibiotic. The principal reasons for the simultaneous use of two different chemotherapeutic agents in treating Staphylococcus infections are summarized by Goodman and Gilman in their recent book. These are the following:

1. To delay the emergence of variants which are resistant to either drug alone.

2. To obtain a much greater or more rapid bacteriostatic or bactericidal effect than accorded by either agent alone in comparable concentration.
3. To take advantage of the differences in toxicity exhibited by the various antimicrobial substances.

The problem of drug resistance has important epidemiologic aspects. As stated in Dubos' recent book, the widespread use of a drug among a population may lead by a selective process to widespread distribution of strains resistant to that drug, and since many (though not all) resistant strains of bacteria appear to be as virulent as their sensitive parents, they persist in the population.

It is hardly necessary to mention that in addition to antibiotic therapy each patient received the usual adjuvants common to otolaryngologic practice today. These were shrinking of congested turbinal mucosa, nasal irrigation, suction, and, where indicated, irrigation of the maxillary, frontal, and sphenoid sinuses.

Fifteen per cent of our ear cases were acute and chronic diffuse purulent external otitis. These figures are lower than those of McLaurin. Because of climatic conditions of extreme heat and humidity in the southern part of the United States, he finds these diseases more prevalent. Veterans arrived from service in the Pacific Islands with a diagnosis of "otomycosis." Yet, at no time did we discover a fungus as the cause of the infection. It was always bacterial. While the color of the discharge was insignificant, frank green pus ususally was later identified with P. aeruginosa.

Clinicians and bacteriologists interested in problems presented by recurrent external otitis should look forward in anticipation to the further reports of Senturia and Carruthers, who are studying the physiology and biochemistry of the skin of the external auditory canal in connection with the bacteriology of various types of external otitis.

SUMMARY AND CONCLUSIONS

A study of purulent infections of the ear, nose, and throat of veteran cases is presented.

These studies show hemolytic Staphylococcus aureus, Proteus vulgaris, and Pseudomonas aeruginosa to be the most commonly encountered pathogens in chronic suppurative disease of the ears, and sinuses.

Individual culture and sensitivity tests are an absolute necessity in evaluation and proper treatment of chronic infections.

The use of two different antibiotics, in treatment, is most forcefully recommended. In attacking the enzyme systems of the bacteria in different ways, the development of resistant strains is prevented.

From a consideration of the studies presented, the impression is strong that both P. vulgaris and P. aeruginosa, in strains obtained from fresh purulent exudate, are becoming more resistant to all available antibiotics.

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The Treatment of Maxillary Sinusitis

The Use of Penicillin Solutions in the Sinus

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The maintenance of ventilation and drainage of the maxillary sinus is a well-established principle in treatment of infections of this cavity. Since the sulfonamides, penicillin, and other antibiotics have been available, most otolaryngologists use them as supportive therapy during the early stages of the acute infection, while others rely on them for a cure. For the subacute and long-standing acute maxillary sinus infections, the same opinions hold.

Opinions as to the value of antibiotics administered topically within the sinuses are quite varied. Ballenger and Ballenger [1] feel that, while concentrations of penicillin greater than 400 units per cubic centimeter inhibit ciliary action in the normal mucosa, instillation of penicillin solutions of 500 to 1000 units per cubic centimeter into the infected maxillary sinus after irrigation is very beneficial. Studies by Fenton and Larsell [2] indicate that penicillin in concentrations of 2000 units per cubic centimeter rapidly destroyed streptococci when applied to the nasal membranes of rabbits. They also state that solutions containing penicillin, 1000 units per cubic centimeter, produce no complaints of local burning or irritation when used in the acutely inflamed sinuses of human subjects.

Van Alyea [3] feels that germicidal solutions injected into the sinuses after irrigation have not produced miraculous results. In discussing chronic maxillary sinusitis, Boies [4] states that although he does not feel penicillin locally is of any value he often instills it following irrigation of the maxillary sinus through the natural opening. Morrison [5] is skeptical of the value of the sulfonamides, penicillin, and tyrothricin when instilled into the sinuses. He feels they are ineffective because of the small quantity of drug used, the weak solutions used to prevent irritation, and the short duration of action before the drug is swept out of the sinus by ciliary action and gravity. Treatment of maxillary sinusitis by local injections of penicillin every three to four hours through an indwelling catheter has been used by Forman.[6] He feels this is of definite value in both acute and subacute maxillary sinus infections as well as in certain selected chronic cases.

It has been my experience that the use of solutions of penicillin of the order of 1000 units per cubic centimeter instilled into an infected maxillary sinus is of little value. During the treatment of a patient with an antrum infection following extraction of an upper molar and perforation of the antrum, it was noted that there was no improvement after six irrigations, followed by instillation of 3 cc. of penicillin in oil, 400 units per cubic centimeter. It was then decided to increase the dosage to 100,000 units in 2 cc. of sesame oil. On the third irrigation the sinus was clear. (The oroantral fistula had healed before any treatment was begun.) A second patient, who likewise had six irrigations at twice-weekly intervals, with no improvement, was given the increased dose of penicillin following irrigation. On the second irrigation the sinus was clear and has remained clear, and surgery is no longer considered necessary in this case. Such unexpected therapeutic success led me to adopt routinely the injection of large doses of antibiotics into infected maxillary sinuses after irrigation.

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In the present series of cases, maxillary sinus infections were taken consecutively without exceptions, whether acute (less than two weeks), subacute (less than six months), or chronic (longer than six months). The penicillin used was an aqueous suspension of penicillin G procaine, 600,000 units in 2 cc. of sterile water. All irrigations and instillations were through inferior meatus puncture for accuracy in diagnosis and treatment. Unless frank pus was encountered, in amounts of 1 cc. or more, a diagnosis of maxillary sinusitis was not made. In subsequent irrigations, the infection was not declared cured until the sinus was completely free of pus or mucus shreds. If the sinus was clear on the second irrigation, then one irrigation was considered curative. If the third irrigation was clear, then two irrigations and instillations were considered curative, etc.

There was a total of 44 maxillary sinus infections in 34 patients. Of these, 34 infections in 28 persons were followed adequately either to cure or to surgery. Sixteen infections were acute and seven were subacute. One-third (11 of 34) of the maxillary sinus infections were chronic. Eight (73%) of the 11 chronic infections cleared in three irrigations or less. Of the three which did not clear, one was in a patient with marked septal deviation and obstruction on the infected side, with recurrent acute tonsillitis. The other two infections were in a patient with bilateral pansinusitis, with marked osteitis of all sinus walls.

Excluding the three infections mentioned above, in which treatment of the maxillary sinus alone could not possibly result in a cure, there remained 31 acute, subacute, and chronic maxillary sinus infections. In all cases, the infection was cleared after the third irrigation and instillation of penicillin (no pus or penicillin recovered on the fourth irrigation). Twenty-seven (87%) were clear after the second irrigation, and 23 (74%) had cleared after a single irrigation and instillation of penicillin solution.

The four sinuses which required three irrigations and instillations of penicillin to cure were in two patients, whose histories are worthy of brief note. The first was a 41-year-old woman who had purulent nasal drainage for many years. Irrigation of both antra on two occasions had no effect on the symptoms or the amount of pus recovered on irrigation. After three irrigations followed by instillation of penicillin, there was complete relief of symptoms and the sinuses were clear on irrigation. Resolution might have occurred sooner, but the patient could come in for treatment only every 7 to 10 days. The second patient was a 29-year-old man with severe allergies to most of the grass and weed pollens. He was treated during the height of his allergic reactions and also had the same penicillin solution used for a purulent left frontal sinusitis, with prompt success. Certainly the congested membranes impeded drainage and prolonged the infection.

DO LARGE CONCENTRATIONS OF PENICILLIN IRRITATE THE SINUS MEMBRANES?

Aqueous penicillin sodium when applied to normal nasal mucous membranes of experimental animals[1] seems to inhibit the ciliary activity when the concentration is greater than 400 to 1000 units per cubic centimeter. There is no literature on the effect of penicillin procaine on the mucous membranes. Nor is there any literature which has come to my attention on the effect of these solutions on diseased membranes. In the cases in which penicillin was used there were no instances of allergic reactions and no evidence of any harmful effect on the nasal membranes. On the contrary, it was remarkable to see the membranes return to a normal appearance, sometimes in just a few days. It seems justifiable to assume that the sinus mucosa shares the recovery. Two cases not reported here in which chlortetracycline (Aureomycin) was used showed no adverse effects, although the patients complained of more throat irritation from the overflow of medication from the sinus than when penicillin was used.

CAN HIGH CONCENTRATIONS OF PENICILLIN BE MAINTAINED IN THE SINUS?

In the first place the penicillin is diluted in the irrigating solution remaining in the

sinus after air is instilled and postural drainage used. Since as much as 10 cc. of irrigating solution might remain, the final concentration of penicillin would be 50,000 units per cubic centimeter, assuming 600,000 units were instilled into the sinus. Second, in those cases which the second irrigation showed no pus, there was no trace of the characteristic chalky penicillin procaine. Where there was pus in the sinus on the second irrigation the chalky penicillin procaine was seen mixed with the pus, unless the second irrigation was more than seven days later. Therefore, it may be assumed that an effective concentration of penicillin can be maintained in the sinus for as long as seven days. Of course, if there is return of ciliary function and natural drainage, then all foreign material will be removed from the sinus, including the remaining penicillin. When this occurs there is obviously no need for therapeutic concentrations of penicillin in the sinus.

IS PENICILLIN EFFECTIVE FOR ALL MAXILLARY SINUS INFECTIONS?

It is somewhat dangerous to draw conclusions from such a small series of cases. In those infections not complicated by mechanical obstruction or x-ray evidence of pansinusitis, all 31 were clear after the third irrigation, 27 were clear after the second irrigation, and 23 were clear after the first irrigation. Treatment was given at three- to five-day intervals. It is obvious that with such rapid clearing of the infection the great majority of the patients are well before cultures and sensitivities can be completed. In fact, it is difficult to persuade the patient who is symptom-free to have another irrigation, just to prove the sinus is really clear.

Another rather pertinent question is whether the bacteria found in sinus infections are sensitive to penicillin. In the routine testing of sensitivities, the concentrations of antibiotics used are those attainable in the blood stream under usual therapeutic conditions. Extremely high concentrations of penicillin within the sinus may completely destroy bacteria which are relatively insensitive to the low concentrations found in the blood. Not only will the penicillin act on the surface, but as it is absorbed through the diseased membrane to reach the lymphatics, it will present high concentrations to any bacteria within the membrane. This is well borne out by the fact that in four of the sinus infections penicillin had been given intramuscularly in therapeutic doses for several days before irrigations were begun and had no apparent effect. Yet, penicillin within the sinus was rapidly effective after systemic therapy had been stopped.

From an analysis of the failures in the chronic infections, it appears that in all there were not only probable permanent changes in the membranes but mechanical obstruction to drainage, markedly swollen membranes due to allergy, or infection of the frontal and ethmoid sinuses. This would serve to emphasize that the cardinal principles of ventilation and drainage are as important as ever in the treatment of sinus infection.

CONCLUSIONS

Penicillin G procaine, 300,000 units per cubic centimeter, is not irritating to the nasal or sinus membranes.

Penicillin G procaine is therapeutically very effective for acute, subacute, and chronic uncomplicated maxillary sinus infections.

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Choice of Anesthesia for Tonsil and Adenoid Surgery in Children

Findings in a National Survey

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Anesthesia has been one of medicine's greatest contributions to humanity. No doubt its use has been a great factor in increasing man's longevity, in that it has made possible corrective surgical procedures that otherwise would have been impossible. But, like every other great advance in medicine, it has been by trial and error that we have arrived at our present stage of progress in this field, and there is still much to be desired.

As a result of anesthetic failures, the terms "cardiac arrest" and "respiratory failure" have become so prominent in our medical literature today that every surgeon and every anesthetist who has the responsibility of another case must ever keep in mind the possibility of their occurrence.

"Cardiac arrest" may simply be a result of anoxemia occurring during an anesthetic procedure, or there may be, as many authorities believe, other factors involved. "Respiratory failure" may be a result of aspiration, hypoxia, laryngospasm, asphyxia, or overstimulation of blocking agents, such as curare, at the neuromuscular junction, with paralysis of the respiratory cage. That either of these can occur, and does occur, as a result of anesthetic procedures is well established by reports in medical literature.

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Beecher and Todd [1] in *Annals of Surgery* in 1954 reported a survey of anesthetic fatalities in 10 leading teaching hospitals. This survey covered anesthetic procedures in 599,548 anesthesias of all types given over a five-year period from 1948 through 1952. There were 384 deaths in this report in which anesthesia either was a direct cause or was a very great contributing factor in the fatality.

The over-all death ratio in this report was 1 in every 1560. When one considers that there are more than 200 teaching hospitals in the United States and reasons that the statistics given by Beecher and Todd are as good as the over-all average, there must have been close to 8000 anesthetic fatalities in this group of hospitals alone over the same five-year period. When these statistics are projected to cover every hospital in every town and hamlet in the United States, one certainly is led to weigh carefully two questions: 1. What is the safest type of anesthesia for this particular procedure? 2. What is the safest method of its administration?

In the field of otolaryngology, since the tonsil and adenoid operation is perhaps the most frequent surgical procedure, it was thought that a national survey might throw some light on what type of general anesthesia and what method of administration were most generally used in our best medical centers. It was felt that our teaching hospitals would be the best source of information on this problem. A questionnaire was mailed to every hospital approved for residencies in otolaryngology and anesthesiology. The questionnaire was mailed to both groups, since in the main they are not duplications.

Hospital Reporting	Insufflation Administration						Endotracheal Administration				Comments
	EE	VE	N_2O-O_2-E	C_3H_8-E	ETH CL-E	BE	N_2O-O_2-E	VE	BE	N_2O-O_2, C_3H_8	
1. Duke Hospital, Durham, N. C.	X	X*	X	..	..	..	..	..	..	..	* Preferred
2. Indianapolis General Hospital, Indianapolis	X*	X	..	..	..	..	..	..	..	..	* Majority
3. Tampa Municipal Hospital, Tampa, Fla.	X	X	..	..	..	..	X	..	..	..	
4. North Carolina Baptist Hospital, Winston-Salem, N. C.	X	X	..	..	..	..	..	..	..	..	
5. St. Vincent's Infirmary, Little Rock, Ark.	X	X	..	..	..	..	X	..	..	..	
6. University Hospital, Ann Arbor, Mich.	X	..	..	..	..	..	..	..	..	..	
7. Harlem Eye and Ear Hospital, New York	X	..	..	..	..	..	..	..	..	..	
8. Bellevue Hospital Center, New York	X	X	..	..	..	..	..	..	..	..	
9. New York Hospital, New York	X*	..	..	..	..	X	..	..	..	X	* Preferred
10. University of Virginia Hospital, Charlottesville, Va.	5%	..	..	..	..	..	48%	47%	..	..	
11. Lloyd Nolan Hospital, Birmingham, Ala.	X	..	..	..	..	X*	..	..	..	..	* Preferred
12. New York Eye and Ear Infirmary, New York	X	X	..	..	..	..	..	..	..	..	
13. Garfield Memorial Hospital, Washington, D. C.	2%	5%	90%	..	..	X*	X*	..	..	..	* Occasionally
14. University of Oregon Medical School Hospital, Portland, Ore.	X	..	..	..	..	..	..	..	..	..	
15. St. Francis Hospital, Pittsburgh	X	X	..	..	..	..	..	..	..	..	
16. St. Francis Memorial Hospital, San Francisco	X	X	..	..	..	..	..	..	..	..	
17. Cleveland Clinic Hospital, Cleveland	X*	X	..	..	..	..	X†	..	..	..	* Majority under 6 yr. † Over 6 yr.
18. University Hospital, Little Rock, Ark.	..	..	..	..	..	..	..	..	..	X	
19. Jackson Memorial Hospital, Miami, Fla.	..	20%	..	..	..	..	..	..	..	80%*	* Cyclopropane
20. George F. Geisinger Memorial Hospital, Danville, Va.	..	X	..	..	..	..	..	..	..	..	
21. Strong Memorial-Rochester Municipal Hospital, New York	..	X	..	..	..	..	..	..	..	..	
22. Hartford Hospital, Hartford, Conn.	..	X	..	..	..	..	..	..	..	..	
23. New York Polyclinic Medical School and Hospital, New York	..	X	..	..	..	..	..	..	..	..	
24. Mercy Hospital, Pittsburgh	..	X	..	..	..	..	..	..	..	..	
25. Presbyterian Hospital, New York	..	..	..	..	..	..	X	..	..	..	
26. Henry Ford Hospital, Detroit	..	X*	..	..	..	..	..	..	..	..	* Crowe-Davis mouth gag
27. Massachusetts Eye and Ear Infirmary, Boston	..	85%*	10%	..	..	X†	..	..	..	3%	* Under 12 yr. † Occasionally
28. Cincinnati General Hospital, Cincinnati	..	X*	X	..	..	..	..	..	..	..	* Occasionally
29. University Hospitals, Oklahoma City	..	..	..	..	..	..	X*	..	..	..	* Drop ether induction
30. Riverside Hospital, Jacksonville, Fla.	..	X	..	..	..	..	..	..	..	..	
31. Grace-New Haven Community Hospital, New Haven, Conn.	..	..	..	..	..	..	X*	..	..	..	* Nasotracheal cyclopropane induction
32. St. Francis Hospital, Hartford, Conn.	..	X	..	..	..	..	X*	..	..	..	* Occasionally ether induction
33. Pittsburgh Medical Center, Pittsburgh	..	X*	..	..	..	X	..	..	..	..	* Under 3 yr.; tribromethanol induction above 3 yr.
34. St. Joseph's Hospital, Joliet, Ill.	..	..	..	..	..	..	..	X	..	..	
35. University of Texas Medical Branch Hospitals, Galveston, Texas	..	..	..	X	..	..	X	..	..	..	
36. Albany Hospital, Albany, N. Y.	..	X	..	..	..	..	..	..	..	X	
37. University Hospitals, Iowa City	..	..	X	..	..	..	..	..	..	..	
38. Roosevelt Hospital, New York	..	X	..	..	..	X*	..	..	..	..	* Tribromoethanol induction
39. St. John's Hospital, St. Louis	..	X	..	..	..	..	..	..	..	..	

40. George Washington University Hospital, St. Louis	..	X	X*	..	..	..	..	..	..	..	* Larger children: N_2O and vinyl ether induction
41. University Hospital, Augusta, Ga	..	..	..	..	..	..	..	..	..	X*	* Barbiturate and cyclopropane induction
42. Doctors Hospital, Washington, D. C	..	X	X*	..	..	X*	..	..	..	X†	* Rarely † Ethylene (some cases)
43. Bridgeport Hospital, Bridgeport, Conn	..	X	..	..	X	..	..	..	..	..	
44. Medical College of Virginia, Richmond, Va	..	X*	..	..	..	X	..	..	..	X	* Preferred
45. University of Kansas Medical Center, Kansas City, Kan	..	X	..	..	..	..	..	..	..	..	
46. Indiana University Medical Center, Indianapolis	..	X	..	..	..	..	..	..	..	..	
47. Grady Memorial Hospital, Atlanta	..	X	X	..	..	..	..	..	..	..	
48. Presbyterian Hospital, Chicago	..	X	..	..	..	..	..	..	..	..	
49. Illinois Eye and Ear Infirmary, Chicago	..	..	..	..	..	..	X	X	..	..	
50. Santa Clara County Hospital, San Jose, Calif	..	..	..	..	..	..	X	..	..	..	
51. Mary Hitchcock Memorial Hospital, Hanover, N. H	..	..	..	..	..	..	X*	..	..	..	* May use vinyl ether induction
52. Maimonides Hospital, Brooklyn	..	X	..	..	..	..	..	..	..	..	
53. Albert Einstein Medical Center, North Division, Philadelphia	..	X*	..	..	..	..	..	..	..	..	* Open drop ether
54. Butterworth Hospital, Grand Rapids, Mich	..	X	X	..	..	..	..	..	..	..	
55. Presbyterian Hospital, Philadelphia	..	X	..	..	..	..	X*	..	..	..	* Orotracheal maintenance
56. St. Elizabeth Hospital, Youngstown, Ohio	..	X	..	..	..	..	..	..	..	..	
57. Mercy Hospital, Canton, Ohio	..	X	..	..	..	..	..	..	..	..	
58. Baroness Erlanger Hospital, Chattanooga, Tenn	..	X	..	..	..	X*	..	..	..	..	* Thiopental induction
59. Robert Packer Hospital, Albany, N. Y	..	X	..	..	..	..	..	..	..	..	
60. Albany Hospital, Albany, N. Y	..	X	..	..	..	..	X	..	..	..	
61. Receiving Hospital, Detroit	..	..	..	..	..	..	X	..	..	..	
62. Ohio State University Hospital, Columbus, Ohio	..	X	..	..	..	..	..	..	..	..	
63. Pennsylvania Hospital, Philadelphia	..	..	..	..	..	..	X	..	..	..	
64. Louisville General Hospital, Louisville	..	X*	X†	..	..	X‡	..	..	..	X†	* Plus oxygen † Occasionally ‡ Rarely
65. Marymount Hospital, Garfield Heights, Ohio	X	X	X	..	..	..	..	..	..	X	
66. Mary Fletcher Hospital, Burlington, Vt	..	..	..	..	..	..	X*	..	..	..	* Vinyl ether and drop ether for intubation
67. Roper Hospital, Charleston, S. C	..	X	..	..	..	..	..	..	..	..	
68. Lowell General Hospital, Lowell, Mass	..	70%	..	..	..	..	.	..	..	30%	
69. Buffalo General Hospital, Hamburg, N. Y	..	..	X	.	..	..	..	..	..	..	
70. Central Maine General Hospital, Lewiston, Maine	..	X	..	.	.	X	.	..	..	..	
71. Bishop DeGoesbriand Hospital, Burlington, Vt	..	..	..	.	.	.	X*	.	..	..	* Vinyl ether and drop ether for intubation
72. Holyoke Hospital, Holyoke, Mass	..	X*	..	..	..	..	..	..	..	..	* Rose position
73. Rochester General Hospital, Rochester, N. Y	..	X	..	..	..	..	..	..	..	..	
74. Hahnemann Medical College and Hospital, Philadelphia	..	..	X	..	..	..	..	..	..	..	
75. Bellevue Hospital Center, New York	X	X	..	..	..	..	..	..	..	..	
76. University of Minnesota Hospitals, Minneapolis	..	..	..	..	..	..	X*	X†	..	..	* I.V. thiopental induction † Very small children
77. St. Vincent's Hospital, Worcester, Mass	..	20%	..	..	80%	..	..	..	..	..	
78. Buffalo General Hospital, Buffalo	..	..	..	..	..	..	..	..	..	X	
79. Detroit Memorial Hospital, Detroit	..	X	..	..	..	..	..	..	..	..	
80. Mount Sinai Hospital, Cleveland	..	X	..	..	..	..	..	..	..	..	

Hospital Reporting	Insufflation Administration						Endotracheal Administration				Comments
	EE	VE	N_2O-O_2-E	C_3H_8-E	ETH CL-E	BE	N_2O-O_2-E	VE	BE	N_2O-O_2, C_3H_8	
81. Huron Road Hospital, Cleveland	X	X	X	X	X	..	..	..	..	X	Also other methods
82. New England Hospital, Boston	..	..	..	X	..	..	..	..	..	..	
83. Jefferson Medical College Hospital, Philadelphia	X	X	X*	..	..	..	..	..	..	..	* Ages 12 to 16 only; combinations of these
84. Peter Bent Brigham Hospital, Boston	..	..	..	..	..	..	..	..	..	..	
85. Samuel Merritt Hospital, Oakland, Calif	..	X	X	..	..	..	..	..	..	..	
86. Millard Fillmore Hospital, Buffalo	..	75%	..	..	..	..	25%	..	..	..	
87. Worcester City, Hospital, Worcester, Mass	..	X	..	..	..	X*	..	..	..	..	* Rectal thiopental induction
88. Beth-El Hospital, Brooklyn	..	X	..	..	..	..	..	..	..	..	
89. Highland-Alameda Hospital, Oakland, Calif	..	X	..	X	..	..	X	..	..	..	
90. Los Angeles County General Hospital, Los Angeles	X	..	..	..	..	..	..	..	..	..	
91. Edward J. Meyer Memorial Hospital, Buffalo	..	75%	..	..	..	..	25%	..	..	..	
92. St. Catherine's Hospital, Brooklyn	..	X	..	..	..	..	..	..	..	..	
93. Mayo Foundation, Rochester, Minn	..	..	..	..	..	..	..	..	X*	..	* Rectal thiopental induction
94. Abington Memorial Hospital, Abington, Pa	..	..	..	..	X*	..	..	..	..	..	* Ethyl chloride induction
95. Vanderbilt University Hospital, Nashville, Tenn	X	..	..	..	..	..	..	..	..	X	
96. New York City Hospital, New York	..	X	..	..	..	..	..	..	..	..	
97. University of Nebraska Hospital, Omaha	..	X	..	..	..	..	..	..	..	X*	* Some
98. Genesee Hospital, Rochester, N. Y	..	X	..	..	..	..	..	..	..	..	
99. University Hospitals, Oklahoma City	..	..	..	..	..	..	X*	X	..	..	* Slater valve
100. Metropolitan Hospital, New York	..	X	..	..	..	X*	..	..	..	..	* Tribromoethanol basal preferred
101. Beth Israel Hospital, New York	..	..	..	..	..	..	X	..	..	..	
102. Albert Einstein Medical Center, Southern Division, Philadelphia	..	X	..	..	..	..	..	..	..	..	
103. St. Elizabeth's Hospital, Boston	..	X	..	..	..	..	..	..	..	..	
104. Memorial Hospital, South Bend, Ind	..	X	X	..	..	X	X	..	..	..	
105. New England Deaconess Hospital, Boston	..	X	..	..	..	..	..	..	..	..	
106. Maine General Hospital, Portland, Maine	..	X	..	..	..	..	..	..	..	..	
107. Cambridge City Hospital, Cambridge, Mass	..	X	X	..	..	X	X	..	..	..	
108. Long Island College Hospital, Brooklyn	..	X	..	..	..	..	..	..	..	..	
109. St. Clare's Hospital, New York	..	X	..	..	..	X*	..	..	..	..	* Rectal thiopental occasionally
110. Grace-New Haven Hospital, New Haven, Conn	..	..	..	..	..	..	..	..	..	X	
111. University of California Hospital, San Francisco	..	..	X	..	..	..	..	..	..	..	
112. McPherson Hospital, Durham, N. C	..	X	..	..	..	..	..	..	..	..	
113. Allegheny Hospital, Pittsburgh	..	X	..	..	..	..	..	..	..	..	
114. Lahey Clinic, Boston	..	..	..	..	..	..	..	..	X*	..	*Thiopental induction, semiclosed Leigh valve
115. Tulane University Unit, New Orleans	..	X	..	..	..	..	..	..	..	..	
116. Highland Hospital, Rochester, Minn	..	X	..	..	..	..	..	..	..	..	
117. Mount Auburn Hospital, Cambridge, Mass	..	X	..	..	..	..	..	..	..	..	
118. Stanford University Hospital, San Francisco	..	X	X	..	..	..	..	..	..	..	
119. Doctors Hospital, Seattle	5%	..	..	..	..	..	..	..	..	95%	
120. King County Hospital, Unit No. 1, Seattle	..	..	X*	..	..	..	..	..	..	..	* With copper kettle
121. Eastern Maine General Hospital, Bangor, Maine	..	X	..	..	..	..	..	..	..	..	

122. Jewish Hospital, Brooklyn	..	X	..	..	..	..	..	..	..	..	
123. Christ Hospital, Cincinnati	..	X	X	..	..	..	..	..	..	..	
124. Newton Wesley Hospital, Waban, Mass	..	X	..	..	..	..	..	..	..	..	
125. Hospital for Joint Diseases, New York	..	X	..	..	..	..	..	..	..	..	
126. Brooklyn Eye and Ear Hospital, Brooklyn	X	X	..	..	..	..	..	..	..	..	
127. Johns Hopkins Hospital, Baltimore	..	X	..	..	..	..	..	..	..	..	
128. Washington University Hospital, St. Louis	..	X	..	..	..	..	..	..	..	..	
129. State of Wisconsin General Hospital, Madison, Wis	..	..	..	..	..	..	X*	X	X	X	* Drop ether also for induction
130. Virginia Mason Hospital, Seattle	..	X	..	..	..	..	..	..	..	X	
131. Massachusetts Memorial Hospitals, Boston	..	..	X*	..	..	..	..	..	..	..	* Also trichloroethylene (Trilene) induction
132. St. Joseph Hospital, Paterson, N. J	..	..	..	..	..	X	..	..	..	X	
133. St. Luke's Hospital, Cleveland	..	X	..	..	..	..	..	..	..	..	
134. Grasslands Hospital, Valhalla, N. Y	..	..	..	..	..	..	..	..	..	X	
135. Receiving Hospital, Detroit	..	..	X	..	..	..	X*	..	..	..	* Chiefly
136. Wesley Memorial Hospital, Chicago	..	95%	..	..	..	..	..	..	..	5%	
137. New England Central Hospital, Boston	X	X	X	X	X	..	..	..	..	..	
138. John Gaston Hospital, Memphis	X	X*	..	..	..	..	..	..	..	..	* Majority
139. Baptist Memorial Hospital, Memphis	4%	95%	..	..	..	1%	..	..	..	..	
140. Ochsner Foundation Hospital, New Orleans	..	..	..	..	..	X*	..	..	..	..	* Rectal thiopental for children under 50 lb.
141. Rhode Island Hospital, Providence, R. I	..	X*	..	..	..	..	..	..	..	..	* N_2O-O_2-VE induction; intubation for respiratory difficulty
142. State University of New York Medical Center, New York	..	X	..	..	..	..	..	..	..	..	
143. Henry Ford Hospital, Detroit	..	X*	..	..	..	..	..	..	..	..	* Crowe-Davis mouth gag
144. St. Vincent's Hospital, New York	..	..	..	..	..	..	X	..	..	..	
145. State of Wisconsin General Hospital, Madison, Wis	..	..	..	..	..	..	..	..	X*	..	* Rectal thiopental induction
146. Ellis Hospital, Schenectady, N. Y	..	X	..	..	..	..	..	..	..	..	
147. Tacoma General Hospital, Tacoma, Wash	..	..	..	..	..	..	..	X	..	..	
148. Temple University Hospital, Philadelphia	X	X	X	..	..	..	X	..	..	..	
149. Lennox Hill Hospital, New York	X	X	..	..	..	X*	..	..	..	..	* Tribromoethanol induction (90%)
150. Parkland Memorial Hospital, Dallas, Tex	..	X*	..	..	..	..	..	25%	..	..	* Majority (plus oxygen)
151. Medical Center of Jersey City, Jersey City, N. J	..	X	..	..	..	..	..	..	..	..	
152. Jefferson Davis Hospital, Houston, Tex	X	..	..	..	..	..	..	..	..	..	
153. San Juan City Hospital, San Juan, Puerto Rico	..	X	..	..	..	..	..	..	..	..	
154. St. Luke's Hospital, New York	..	X	X	..	..	..	..	..	..	..	
155. White Memorial Hospital, Los Angeles	..	X	..	..	..	..	X	..	..	..	

The abbreviations are as follows: EE, drop ether with ether maintenance; VE, vinyl ether induction with ether maintenance; N_2O-O_2-E, nitrous oxide-oxygen induction with ether maintenance; C_3H_6-E, cyclopropane induction with ether maintenance; ETH CL-E, ethyl chloride induction with ether maintenance; BE, basal induction (thiopental or tribromoethanol) with ether maintenance; (N_2O-O_2, C_3H_6), nitrous oxide oxygen or cyclopropane.

The response to the questionnaire has shown a very wide interest in this question and has been almost unanimous. In addition, many letters have been received with more detailed information than could be given in the questionnaire. There were many write-ins on returns from the questionnaire. In tabulating the data the Table was enlarged to include all the information given in the replies. Special comments are noted.

COMMENTS AND CONCLUSIONS

Most of the hospitals responding to this survey expressed a multiple choice, depending upon the age and size of the child, in most cases. In teaching hospitals the choice is not always the same for clinic patients as in private practice, since the anesthesia and its method of administration are part of the training for interns and residents. Also, the choice of the anesthesiologist is not always the choice of the surgeon.

The Table covers data furnished in reports from 155 teaching hospitals. From a careful analysis of the data furnished it is evident that the choices of anesthesia for tonsil and adenoid surgery in children, in the order of frequency of selection, are the following:

1. Vinyl ether (Vinethene) induction with ether maintenance by insufflation administration
2. Drop ether for induction with ether maintenance by insufflation administration
3. Nitrous oxide-oxygen induction with ether by endotracheal administration
4. Nitrous oxide-oxygen induction with ether maintenance by insufflation administration
5. Nitrous oxide or cyclopropane by endotracheal administration
6. Basal induction (thiopental [Pentothal] sodium or tribromoethanol [Avertin] by rectum) with ether maintenance by insufflation administration
7. Vinyl ether induction with ether maintenance by endotracheal administration
8. Rectal thiopental or tribromoethanol induction with ether maintenance by endotracheal administration
9. Cyclopropane induction with ether maintenance by insufflation administration
10. Ethyl chloride induction with ether maintenance by insufflation administration

Reports from many hospitals specify the use of a Crowe-Davis, Barton-Davis, Davis, or some modification of this type of mouth gag. The Rose position is the choice of many. Supplementary oxygen, either by nasal catheter or orally, along with the anesthetic agent is also a frequently specified part of the routine. Intubation with tracheal catheter and endotracheal administration of the anesthetic agent is, not surprisingly, becoming more widely used, and in the hands of the well-trained anesthetist its margin of safety is well recognized.

Information given in the questionnaire also covered tonsillectomy in adults requesting a general anesthesia, but the data given are too voluminous to be given in a single paper.

Detailed letters, statistics, and helpful suggestions in correlating the data were given by the Massachusetts Eye and Ear Infirmary, Portland Memorial Hospital, Ochsner Foundation Hospital, Rhode Island Hospital, Louisville General Hospital, Parkland Hospital, and Henry Ford Hospital. Dr. Ray G. Stark, Chief of Anesthesiology, Baptist Hospital, Memphis, and Dr. Mary Frances Poe, Chief of Anesthesiology, John Gaston Hospital, Memphis, provided help and suggestions in correlating the data given in this report.

REFERENCE

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Induced Paralysis for Endoscopic Procedures

A Preliminary Report

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Initially, endoscopy was primarily therapeutic, with its use devoted to the removal of foreign bodies. Although this function has retained its importance, diagnostic endoscopy is now the major practice. Tremendous advances in equipment and technique have been made in the past two decades, making peroral endoscopy indispensable to the diagnosis of diseases of the respiratory and alimentary tracts.

Unfortunately, the strides in operative technique have not been accompanied by comparable advances in anesthetic procedures. Although topical anesthesia is used successfully in many endoscopic procedures, it is frequently inadequate, often causing reluctance in the patient to accept the procedure or hesitation on the part of the referring physician to subject his patient to it.

To compensate for the failings of topical anesthesia, general anesthesia has been tried. Inhalation anesthetics or the intravenous short-acting barbiturates, following topical agents, were initially suggested, but those held too many hazards. Then topical anesthesia, combined with general anesthesia and curare-like drugs, was employed, with greater success.[1] Recently, succinylcholine chloride has been used to supplement general anesthesia. Therefore, we considered the use of succinylcholine chloride with local anesthesia. We then theorized that the topical anesthesia might be superfluous and succinylcholine chloride alone would be adequate.

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From U. S. Army Hospital, Camp Gordon, Ga.

PHARMACOLOGY OF SUCCINYLCHOLINE CHLORIDE

Succinylcholine chloride, also known as diacetylcholine chloride, consists of two molecules of acetylcholine chloride, linked together at the alphamethyl group. It has an extreme potency, which produces consistent and rapid muscular relaxation in short duration. Its action, similar to that of acetylcholine, entails the depolarization of an area on the muscle membrane in the region of the motor endplate.[2] It has been assumed that this depolarization is accomplished by the inhibition of the true acetylcholinesterase at the myoneural junction.[3] The resulting excess of acetylcholine prevents repolarization of the depolarized area on the muscle membrane, causing it to remain unresponsive to further stimuli.[4]

Therefore, curare antidotes, such as neostigmine (Prostigmin), edrophonium chloride (Tensilon), etc., should not be used, as they would prolong the paralyzing effect. However, in the event that a prolonged paralysis occurs in a case of myasthenia gravis, cholinergic drugs like neostigmine and edrophonium can be used to counteract its effects.[2]

Succinylcholine is a competitive inhibitor of acetylcholine hydrolysis by both the true acetylcholinesterase and the pseudocholinesterase. It can be metabolized only by pseudocholinesterase of the serum, using succinylmonocholine as an intermediary step, into natural metabolites, choline, and succinic acid.[5] The potency of the drug can be predicated on a milligram per kilogram body weight basis,[6] and its destruction is so rapid under normal conditions that no antidote is considered necessary.[7]

Succinylcholine has an extremely low toxicity: Animals maintained on artificial respiration tolerated, without any demonstrable changes, doses several thousand times the paralyzing dose.*

Some observers have found that succinylcholine chloride in therapeutic doses,[6] and even in doses several times the paralyzing dose,[7] has no direct effect upon pulse rate and blood pressure. Others [10] have observed slight rises in blood pressure with therapeutic doses and moderate increases, accompanied by some slowing in the pulse rate, in cases where 10 to 20 times the therapeutic doses were administered. In a small percentage of instances they also noticed occasional premature ventricular contractions and transient nodal rhythms.

In persons with a low plasma titer of pseudocholinesterase, such as patients with liver disease, severe malnutrition, and severe anemia, a prolonged action of succinylcholine may be expected,[8] necessitating, therefore, somewhat smaller doses. If, however, a prolonged paralysis should occur, plasma pseudocholinesterase levels can be increased by blood or plasma transfusions.†

A few cases of prolonged apnea, not contributable to a decreased titer of plasma pseudocholinesterase, have been observed. Some of these are believed to be due to a central respiratory depression,[12] while some others may be due to hyperventilation.[10]

Other than the possible central respiratory depression, we have been unable to find any reports of further effects of the drug on the central or the autonomic nervous system. Martin and associates [10] saw no evidence of histamine liberation in a series of 650 surgical patients.

Succinylcholine chloride is administered intravenously either by a single injection of a 2% solution or by a continuous infusion of a 0.1% solution. Because of its versatility it has been used in conjunction with general anesthesia for a wide variety of purposes, such as continuous relaxation for abdominal surgery, facilitation of endotracheal intubation, endoscopic procedures, the treatment of laryngospasm and hiccups, the prevention of traumatic injuries from electroconvulsive therapy, etc.

The self-experimentation of Mayrhofer [7] shows that succinylcholine chloride has no subjective or objective side-effects upon a conscious person.

* References 8 and 9.

† References 4 and 11.

Data Concerning Twenty-Two Patients on Whom the Endoscopic Procedure Was Performed Utilizing Induced Paralysis

Case No.	Age	Sex	Race	Endoscopic Procedure	Duration of Endoscopy, Sec.	Dosage of Succinylcholine Chloride, Mg.	Duration of Required Artificial Respirations, Sec.
1	57	M	W	Esophagoscopy	168	80	420
2	26	M	W	Laryngoscopy	186	65	281
3	29	F	W	Bronchoscopy	207	55	306
4	20	M	W	Bronchoscopy	281	70-25	418
5	19	M	W	Bronchoscopy	174	65	264
6	26	M	N	Laryngoscopy	177	75	288
7	24	M	W	Laryngoscopy	165	65	279
8	24	M	W	Laryngoscopy	150	70	264
9	25	M	N	Bronchoscopy	261	80	441
10	22	M	W	Bronchoscopy	171	65	285
11	24	M	N	Bronchoscopy	390	70-25	600
12	25	M	N	Bronchoscopy	285	80-25	421
13	26	M	W	Bronchoscopy	324	70-25	429
14	25	M	W	Esophagoscopy	219	70	312
15	20	M	W	Bronchoscopy	234	60-20	460
16	24	M	N	Bronchoscopy	240	70	306
17	35	F	W	Bronchoscopy	186	60	284
18	34	F	W	Laryngoscopy	150	60	270
19	37	M	W	Bronchoscopy	207	75	312
20	17	M	W	Esophagoscopy	540	70-25-25	660
21	32	M	W	Bronchoscopy	174	80	288
22	28	M	N	Bronchoscopy	248	85	312

METHOD

Twenty-two endoscopies (Table) were performed utilizing induced paralysis. Because of the psychological aspects involved, we found that the success of the procedure depends greatly upon the initial contact of the patient and the anesthesiologist.

Since there exists a strong possibility of fear developing during the transient paralysis, we considered it essential that the patient have complete confidence in the anesthesiologist. This can best be obtained on the preoperative visit, wherein the anesthesiologist not only acquaints himself with the patient's physical condition but also his mental attitude.

The anesthetic and endoscopic procedures, with expected durations, are explained. The patient is advised that although consciousness will be retained at all times, pain or discomfort will be minimal during the endoscopic procedure.

In order to allay his apprehension, the word "paralysis" is avoided and the term "complete muscle relaxation" substituted. The patient is informed that due to this relaxation voluntary movements, including respiration, will be impossible. However, this should not cause concern, as constant supervision will be maintained by a qualified specialist, who will assist respirations and assure adequate amounts of oxygen at all times.

It is advisable that the anesthesiologist discuss the case thoroughly with the endoscopist before making his preoperative visit. It is imperative that he be capable of answering any questions the patient may have pertaining to his disease or the endoscopy. The interest shown by the anesthesiologist may do a great deal toward instilling the patient's trust.

A sedation, consisting of 10 to 16 mg. of morphine sulfate, is administered one hour before the endoscopy. An additional 50 to 100 mg. of methantheline (Banthine) is administered orally for esophagoscopies and laryngoscopies.

An intravenous drip with isotonic saline solution is begun in the operating room. Intravenous methantheline is employed to increase the heart rate to 100 to 120 beats per minute. For every 25 to 40 beats per minute elevation desired, 1 mg. of methantheline is administered. Subsequently, the patient is allowed to breathe pure oxygen for one to two minutes.

The precalculated dosage of succinylcholine chloride (1 mg. per kilogram body weight in obese and 1.25 mg. per kilogram in asthenic persons) is slowly administered intravenously. Adequate relaxation of 300 to 400 seconds' duration can be expected. As soon as the paralysis extends to the diaphragm, artificial respiration, by rhythmic compressions of the chest (rate of 25 to 30), is begun. Simultaneously, the endoscopist receives word to proceed. Additional oxygen (6 to 8 liters per minute) is infused through the oxygen inlet of the bronchoscope or ether hook in laryngoscopy and esophagoscopy. In cases of prolonged endoscopy, one-third of the original dose of succinylcholine chloride is readministered upon the first sign of the return of muscle tone.

As soon as the endoscope is removed, an oxygen mask is applied. Respirations are first controlled, and then assisted, by manually compressing the bag of the anesthesia machine. If increased amounts of saliva are present, oropharyngeal suction is used. As soon as adequate respirations are resumed, oxygen is discontinued. Approximately five minutes later, the patient is returned to his ward. He is ambulated as soon as the effects of the premedication have worn off.

Complete electrocardiographical studies were performed immediately preceding and following the endoscopy. During the entire procedure, beginning with the injection of succinylcholine chloride and ending with the resumption of adequate respiration, Lead II was used for tracing. The only exception was in Case 14, where Lead I was used.

Systolic and diastolic blood pressures were recorded before, during, and after the procedure. Arterial oxygen saturation was determined by oxymetry.

In Cases 1 to 5, topical anesthesia with cocaine was produced in routine manner before the induction of paralysis.

RESULTS

Good psychological contact was established with all patients, with the exception of Cases 7, 13, 14, 19, 20, and 22.

In Case 1, a patient with a moderately severe liver cirrhosis, a low plasma pseudocholinesterase level was expected. Therefore a dosage of only 0.5 mg. of succinylcholine chloride per 1 kg. of body weight was administered. Adequate relaxation for a duration of 168 seconds, the time necessary for the esophagoscopy, was achieved. Respirations had to be assisted for 420 seconds. There were no outward reactions, and the patient appeared quite comfortable during the entire procedure.

In five cases (4, 11, 12, 13, and 15), where the operating time elapsed was from 281 to 390 (average: 303) seconds, an additional one-third of the original dose of succinylcholine chloride had to be administered in order to assure muscular paralysis of adequate duration. In these cases it was necessary to control and assist respirations for 418 to 600 (average: 466) seconds.

In one prolonged esophagoscopy for foreign body (Case 20) two subsequent doses of one-third of the original amount of succinylcholine chloride had to be administered in order to assure adequate relaxation for the duration of the entire procedure, lasting 540 seconds. Respirations had to be assisted for 660 seconds.

In the remaining 15 cases the original calculated dose of succinylcholine chloride produced complete muscular paralysis of adequate duration to complete the entire endoscopic procedure, entailing an interval of from 150 to 261 (average: 194) seconds. Controlled and assisted respirations were necessary, in these cases, for an average of 300 (264 to 441) seconds.

All patients were aware of the insertion of the endoscope. However, in the majority of instances, there was no discomfort associated with it. Although it was never disturbing, some discomfort of short duration was felt by three patients (Cases 4, 11, and 16). Not a single patient felt pain at any time.

All of our cases were entirely free of laryngospasm, hiccups, nausea, and vomiting.

Muscular twitchings during the induction of paralysis were noticed occasionally. However, these were never accompanied by any pain or discomfort.

In the majority of cases, muscular paralysis caused no discomfort or fear. Only four patients (Cases 13, 14, 19, and 22) reported that they were somewhat frightened and experienced some respiratory distress.

Increases in systolic and diastolic blood pressures were common. The highest peaks were as high as 90 mm. Hg (usually 40 to 60 mm. Hg) above the preoperative levels. Occasional ventricular premature contractions and transient nodal rhythms were noted.

All patients, including those complaining of respiratory distress during paralysis, agreed that the entire procedure was relatively comfortable. They further stated that in the event that another endoscopy should prove necessary they had no objections to the method employed by us. Cases 6, 13, and 15 had undergone previous endoscopic procedures of the same type performed under topical anesthesia; all preferred the "relaxation technique."

COMMENT

Good psychological contact between patient, anesthesiologist, and members of the surgical team is considered to be of great importance to the success of any operation.[13] It is especially important when dealing with paralyzed conscious patients. Avoidance of anxiety is essential, because apprehensive people overreact to pain as well as to other sensations.[14] Despite the fact that the skin remained sensitive to mechanical pain, real discomfort or pain due to endoscopy was not observed. The only four cases of fear and distress from respiratory paralysis occurred among the six patients with whom adequate psychological contact was not established. In Cases 13 and 19 the respiratory distress may have been partially due to inadequate respiratory exchange because of pulmonary fibrosis and emphysema, but in Cases 14 and 22 no physiological cause was detectable. We believe that in all of these cases anxiety

played at least a contributory role; a more complete preoperative discussion and verbal reassurance during the procedure may have reduced or eliminated the distress and fear.

Our oxymetric studies demonstrate that by using the described method the arterial blood oxygen saturation can be easily maintained, during the entire endoscopy, at or above the preoperative levels. However, during the 20 to 30 seconds necessary for changing from manual chest compressions to positive pressure breathing, a drop of 10%-15% may occur. This, of course, may be corrected with a few breaths of 100% oxygen.

King and associates,[15] in analyzing peak blood pressures in conscious persons during endotracheal intubation under topical anesthesia, found that the average increase in systolic blood pressure over the resting blood pressure level was 82 mm. Hg, the highest increase being 171 mm. of Hg. The complete elimination of coughing and gagging and the maximal relaxation obtained in our cases can be assumed to have helped to minimize these extensive peak increases in blood pressure, despite the more extensive endoscopic procedures and lack of topical anesthesia. Whether succinylcholine chloride itself, which has been reputed to cause some blood-pressure increases,[10] played a contributory role remains to be answered.

By increasing the heart rate, with either sympathomimetic or parasympatholytic drugs, we were able to decrease the incidence of premature ventricular contractions and transient nodal rhythms. The ideal heart rate, in most instances, appeared to be 100 to 120 beats per minute. Tachycardia of this degree, while not high enough to cause concern in itself, eliminated all arrhythmias in the majority of cases. We found the most effective method of increasing the heart rate to be the use of intravenous methantheline one to two minutes prior to the administration of succinylcholine chloride. The use of methantheline was especially beneficial in bronchoscopies, as it decreased excessive salivation without jeopardizing the collection of endobronchial secretions.

Our series of cases in which succinylcholine chloride alone was employed in the preparation of the patient for endoscopy is extremely small. Despite this, the results obtained were remarkable enough to warrant this preliminary report, as both operator and patient gained numerous advantages.

In considering the use of topical anesthesia for endoscopic procedures, the endoscopist confidently approaches the lean, long-necked, edentulous patient who has a large mouth, small tongue, and complacent attitude. However, he feels apprehensive, and rightly so, when confronted with the thick-necked, heavy-set, obese patient with prominent teeth, a large tongue, and unstable nervous system. As all patients are placed in the same state of relaxation with succinylcholine chloride, the physical contraindications can be dismissed. Moreover, it is expected that with proper psychological preparation even the most apprehensive person will react favorably to endoscopic procedures performed under succinylcholine chloride.

Directly related to the selection of the patient is the consideration of the patient's comfort. In our group of cases, each patient was extensively questioned immediately following the operation and a few hours later. Without exception, the complaints offered regarding the actual operation were negligible. This must be contrasted to the very frequent untoward reactions to endoscopy under topical anesthesia.

The operator should have much less difficulty inserting the endoscope into the desired area, as resistance to the scope is minimal. In direct laryngoscopy, exposing the anterior commissure is no problem, making diagnosis and treatment effortless and efficient.

Following the insertion of the endoscope, examination is remarkably easy. The laryngobronchial tracts stay at maximum size, with no gagging or coughing to distort the field. In this series of cases, it seemed that the bronchial divisions were more accessible to direct vision and the use of the telescopes expedited. Explosive expirations from coughing were absent, creating a certain safety factor for the operator.

In all forms of endoscopy, therapeutic problems or biopsies become more simplified. Movement of the patient can be eliminated if necessary. Spasm around the foreign body is abolished. A lesion, if existing, is not distorted or diminished in size.

A feature of surgery should never be speed; on the other hand, wasted time is not advisable. By employing succinylcholine chloride, an endoscopic procedure should take a minimum of time, with a maximum of efficiency.

Throughout literature mention is made of the anesthetic and operative hazards of peroral endoscopy. It is felt that the risks of a serious accident are not high but that it is an ever-present possibility.

The most frequently mentioned hazard is that of topical anesthetic reactions. Unfortunately, severe reactions have resulted in death, as marked sensitivities can waylay the most careful precautions when dealing with cocaine or the cocaine-like drugs.

Injury to the cervical spine and its contiguous part is not unheard of. Under topical anesthesia the resistance of a patient against the endoscope can result in untoward vertebral strains. Succinylcholine chloride affords complete muscular relaxation, allowing the neck to be rotated smoothly and gently, with less risk. Occasionally, endoscopy is necessary for a patient who has severe trismus of the masseter muscles. Relaxation is impossible with topical agents. This is obviated by succinylcholine chloride.

Perforation of the esophagus is a major complication in esophagoscopy and remains a thorn in the side of the esophagologist. Despite care on the part of the surgeon, it can still occur occasionally. This procedure, using induced paralysis, can not assure protection from perforation but will lessen its chances of occurring. Again, the resistance of the patient is counteracted and the thin esophageal wall is less likely to be traumatized. It is felt that the techniques of esophageal bouginage would be enhanced by this method.

Induced paralysis can be used on any candidate for peroral endoscopy. It is, however, doubtful that this procedure should supplant the standard and accepted preparation of the patient with topical anesthesia. Many patients have no difficulty with the latter. In addition, in bronchoscopy many cases require combined diagnostic and therapeutic procedures, viz., bronchiectasis. Frequently the secretions are at a premium and demand forceful coughing during the endoscopy to eject them from bronchioles into the path of the bronchoscope. Under the influence of succinylcholine, the patient is unable to cough and thus a thorough toilet of the tracheobronchial tree is difficult. Similarly, the collection of droplets of secretion from distal areas are rendered inaccessible.

Unless it is felt that the patient would be physically or psychologically unfit for topical anesthesia, bronchoscopies probably should be continued to be performed under topical agents. Laryngoscopies or esophagoscopies usually will be better, for both operator and patient, using succinylcholine chloride.

SUMMARY

A technique for endoscopic procedures using induced paralysis obtained by succinylcholine chloride unaccompanied by either topical or general anesthesia is described. Twenty-two cases are presented and analyzed. The necessary proper psychological approach is stressed. The advantages and disadvantages to both operator and patient are discussed.

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Vocal Muscular Development

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About 100 years ago, Morrell Mackenzie made the following statement: "A singer's thyro-arytenodei should be in as good condition as a pugilist's biceps." No one familiar with the physiology of the larynx could possibly take exception to this remark, for the thyroarytenoid muscles are the most important factors of the whole tone-producing mechanism.

It is, however, one thing to accept a theory and something very different when the attempt is made to put it into practice. And it is with the utter failure to profit by this succinct statement and to supply singers and speakers with the means whereby they can strengthen these muscles that I am deeply concerned.

The principle of muscular development is that of contraction and relaxation. Therefore, in order to develop the thyroarytenoids there must be contraction and relaxation. These muscles are chiefly concerned with the production of pitch; not only do they bring about the necessary tension of the cords to produce the upper tones of the voice, but, by their action in rotating the arytenoid cartilages and pressing the rear edges of the cords together, they dampen a portion of the cords, thus shortening them and making the production of high tones possible. In cases of paralysis of the thyroarytenoids the higher tones can be produced only with great exertion and then only by calling in the aid of the swallowing muscles. The results thus achieved are unsatisfactory in the extreme, and attempts to produce tones in this manner soon result in a condition of hoarseness, which renders even speech difficult or impossible.

In his book "The Natural Method of Voice Production" (Schirmer, 1915) Dr. Floyd S. Muckey in collaboration with Prof. William Hallock (Professor of Physics, Columbia University) proved conclusively that the voice functions as a stringed instrument, giving forth a fundamental tone and overtones in the same ratio as that yielded by instruments such as the violin, piano, etc. The fact that air is used to generate the tone has caused much confusion, and there are many who still cling to the belief that the voice belongs in the category of wind instruments. In a stringed instrument the pitch is raised by shortening the string and increasing the tension. To take the violin as an example, its four strings remain at the same degree of tension but are shortened by the fingers of the violinist. When the limit of pitch produced by one string has been reached the player moves to another string, which is thinner and has greater tension, and proceeds to shorten this until the limit has been reached, and so on. In the voice similar changes are produced by the action of the laryngeal muscles, which follow the dictates of the ear, all these changes taking place without the singer's conscious cooperation. In other words, it is impossible to work the vocal muscles in any way except through the medium of the ear. How sensitive this adjustment is will be realized when we find that it is possible for a singer to sing in tune with a piano which may vary ever so slightly from the one to which he has become accustomed without any conscious readjustment taking place. We are dealing with a mechanism which is definitely not subject to conscious control. This obviously complicates the matter of muscular

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development, rendering a direct approach impossible.

Since, as has been stated, the thyroarytenoid muscles are actively concerned with the production of the higher tones, and since high tones call for greater tension than low tones, it is to the higher tones that we must turn in order to give these muscles their proper exercise. Here again we have a theory which is deceptively simple, and yet its application presents serious difficulties.

Of these difficulties, the most serious is the fact that the attempt to sing high tones is as a rule the prime cause of vocal trouble among singers. Since weak muscles are the result of insufficient exercise, any singer who gives evidence of weak vocal muscles has not given these muscles proper exercise. However, every singer is obliged to sing high tones, and since high tones provide exercise for the thyroarytenoids, how can it be possible that the singing of high tones can result in the weakening of these muscles?

In the September, 1952, *Annals of Otology, Rhinology and Laryngology* I described the method of "finger palpation" which, if used correctly, will unfailingly determine whether a singer or speaker is making use of the external muscles, when producing tone. And it is the unwitting contraction of the external muscles, that is, the swallowing muscles, which inhibits the free action of the vocal muscles proper, in particular the thyroarytenoids. The more the external muscles are brought into action, the less the true vocal muscles are being exercised. Being denied exercise they become weak, and the singer becomes more and more dependent upon this external help.

We have here literally a vicious circle into which both singers and speakers are drawn, and unless they are shown how to break this circle their careers must inevitably suffer. When the vocal cords are forced together by external pressure, the edges become irritated and thickened, so that the speaking voice sounds hoarse and rough. The singer finds that his voice, particularly the upper range, responds less easily, and, in fact, the range will tend to contract, high tones being possible only by the employment of greater and greater force.

It would be unfair even to suggest that medical men have not spent much time in research seeking the solution to vocal problems, but they have been all too frequently handicapped by a lack of practical knowledge of the voice. This has led them into many blind alleys; one of the most usually encountered is the belief that the successful singer must necessarily sing correctly. Nothing could be further from the truth. Many of the great singers of the past abused their voices unmercifully, and this is equally true of present-day singers. Superlative vocal equipment will withstand almost any type of maltreatment, often for a considerable period of time. Many serious musicians believe that the records made by Caruso have adversely affected the singing of many tenors who attempted to imitate his style of singing, and yet who could deny that Caruso had a phenomenal career? It is interesting to recall that during Caruso's career the late W. J. Henderson spoke of the deterioration of his beautiful voice being due to forcing and how on several occasions he was obliged to stop singing to allow his voice to recuperate. If such things can happen to one so greatly gifted, what can be expected of those who are less fortunate? It is customary to assume that a singer's voice must inevitably deteriorate, and when a singer reaches his 60's and is still able to sing, it is considered to be headline news. If a man of 80 or 90 is able to walk and talk, this is by no means considered to be unusual, and there is no fundamental reason why the vocal muscles should deteriorate more rapidly than other muscles of the body. Muscles deteriorate when they are not given proper exercise, and this is precisely what happens to the thyroarytenoids. The singer who knows how to stimulate the action of his vocal muscles can sing as long as he can talk, and this without any change in the quality of his voice. Anyone who has followed the reviews of singers in the daily papers cannot have

failed to notice the very monotonous repetition of "good voice, poor technique," such remarks referring not only to the beginner but also to the experienced artist.

The answer to vocal problems must not be sought in the tones nor in the opinions of singers, no matter how famous they may be; it lies in the function of the human throat. Without an understanding of the complicated processes which occur when tones are produced and what prevents them from being produced freely, there never will be a body of true knowledge of the human voice. To believe otherwise would be tantamount to believing that every nonagenarian reaches his ripe age because of some fanciful belief or practice which may have appealed to him. No one for a moment would consider such a procedure scientific, and yet it is precisely such an attitude which we find in most studies of the voice. Medical men are by no means the only ones who have been misled in their investigations. Voices have been photographed and analyzed and conclusions reached without the investigators having the slightest idea whether the subject whose voice was being photographed was speaking or singing correctly. I have no doubt that this will seem impossible and fantastic, but anyone who will take the trouble to investigate some of these "findings" will soon realize that I have not exaggerated the situation. And supposing the voice of a famous singer has been photographed and analyzed so that every detail of the tone produced has been recorded, are we to present the charts and graphs to the young singer and say, "This is how it should be"?

The problem which faces every singer and, in fact, everyone who uses his voice professionally is to find out how to develop an organ which does not respond to conscious control. He need by no means know the names of the muscles involved nor even their actions, but he must be given concrete advice as to how to prevent the vocal muscles from being interfered with. The principle involved is simple, its application reasonably difficult, but, after all, difficulties are part and parcel of the learning of any skill. The late Dr. Lee M. Hurd once said to me, "Singing is musical athletics," and he was eminently right. With well-developed vocal muscles a singer can look forward to a long career and will be able to avoid many of the troubles which afflict singers. He will enjoy singing, and he will find that the difficulties and fears which have hitherto plagued him will inevitably disappear.

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Rhinologic Versus Orthopedic Rhinoplasty

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It is generally admitted that the details of the rhinoplastic operation offer no great problem even to the humblest surgeon. Why, then, does it represent a utility of value to a relatively small number of rhinologists? What is it that prevents its general adoption?

The purpose of this paper is an attempt to answer the above questions and perhaps to lay down a few principles, to save the novice the wreckage that lies along the path of trial-and-error experience.

To bring out the advantages of the rhinologic concept, let us compare it with the orthopedic philosophy as originated by Joseph.[1] To understand his operation, one must know something of the man himself.

Jacques Joseph [2] was born in Koenigsberg, Prussia, in 1865 and received his medical training in Berlin. After a few years of general practice, he directed his attention to orthopedic surgery. From this he gradually turned to the little-known field of rhinoplasty. This predilection was probably the result of a talent for drawing, which he possessed from early childhood. Like all pioneers, he met considerable opposition from his colleagues. Some regarded his surgery as lying outside the legitimate scope. Others felt that he was "interfering with the will of God." The renowned von Bergmann publicly ridiculed his operation as pandering to the vanity of the patient. But the insatiable energy and zeal with which he labored in his chosen field in time forced recognition of his brilliant contribution. In 1898 he presented the endonasal approach for the correction of nasal deformities [1] and deemed himself the unquestionable inventor of this method. During World War I he was placed in charge of the Department of Facial Surgery by order of the Prussian Ministry. Joseph died fully acclaimed in February, 1934, at the age of 69. It is regrettable that there is no memorial to this man, to whom we owe so much. In the words of Horace,[3] however, he has "erected a monument more lasting than bronze" in his work.

It would be less than just, however, to ignore the priority of John Orlando Roe (1848-1915), an otolaryngologist of Rochester, N. Y., who received his medical education at the University of Michigan and at the College of Physicians and Surgeons in New York. Delavan [4] writes that, eager for additional knowledge, he

> went abroad where he devoted two years of particularly earnest work in the clinics of Vienna, London, and Berlin. His unusual ability was everywhere recognized, particularly by Sir Morrell Mackenzie, with whom he spent much time and by whom he was accorded many desirable privileges, among them an active membership in the British Medical Association, an honor rarely conferred upon one of foreign birth.

Roe opened his practice in Rochester, where he "quickly made a position for himself which was not long in being generally recognized. He acquired a large practice and was for many years a laryngologist to the Rochester Hospital." [4] He was the recipient of many honors, including a Fellowship in the American Laryngological Association at its first meeting, in 1879.

> He was elected president of the Association in 1898. He had also been at different times president of the Medical Society of the State of New York. . . . But of all the honors which he received, none touched him more deeply nor gave him greater satisfaction than the degree of LL.D., bestowed upon him by his Alma Mater in 1913.
>
> Dr. Roe's original contributions to the science of medicine in his department were many and highly valuable. This could hardly be otherwise in view

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of his temperament, and his mental ability. Possessed of unusual modesty—indeed, of diffidence—his energy, perseverance, and hopefulness enabled him to surmount obstacles which in the way of others had proved impassable, for to the attainment of the highest success he brought all of the necessary qualifications, each one of these traits developed in him in an equal degree. It can be said of few men that they stand paramount in literary ability combined with ripe scholarship. . . .In the operative treatment of the nose, Roe was preëminent. . . . In the repair of nasal deformities he stood alone. Indeed, many of the most popular of the present day methods were originated by him. This is especially true of the submucous method, as applied to the septum and to the nasal bones. It seems unfair that he should not receive the credit due him in this important department. Long before Killian's name appeared Roe had been teaching the very same principles which govern the septum operation. Indeed, there are few recesses of our art which were not illustrated by the light of his genius.[4]

On Feb. 1, 1887, at which time Joseph was but 22 years old, Roe read a paper[5] before the Medical Society of the State of New York (later published under the title "Deformity Termed 'Pug-Nose' and Its Correction by a Simple Operation"). In this he describes the endonasal approach and states: "Great care must be exercised not to cut through into the skin, lest we have afterward a scar or dent in the external surface of the nose." Four years later, Feb. 6, 1891, before the same medical society, he read another paper,[6] entitled "The Correction of Angular Deformities of the Nose by a Subcutaneous Operation." Here he expressed himself as follows:

It is my purpose to describe to you, in this short paper, an operation for the correction of angular deformities of the nose by a subcutaneous operation. . . . In all surgical operations about the face, it is as necessary to avoid mutilation of the skin as to correct deformity for an unsightly blemish. It is for this reason that many deformities of the face, and particularly of the nose, are allowed to go uncorrected, which are a *marque de reconnaitre* for every one who sees them, and a constant source of annoyance to the persons themselves.

After anesthetizing the part with cocaine, both by applying it to the interior of the nostril and by injecting some under the skin with a hypodermic syringe, I made a lineal incision completely through the upper wall of the left nostril, to the under side of the skin. This incision I widened laterally from the insertion of the upper border of the triangular cartilage half-way down the side of the nose, until I had a sufficiently large opening to permit the introduction of instruments freely. I then raised the skin from the bridge of the nose over the region where the operation was to be performed. After the skin was sufficiently freed from the top of the nose, I inserted a pair of angular bone-scissors and cut off the projecting piece of bone until the top of the nose was perfectly straight and smooth. The operation was done with the strictest antiseptic precautions, and after completion I blew in some iodoform powder, through the opening, over every portion of the wounded surface. The skin was then allowed to drop back upon the bridge of the nose, and, by strapping it down with gentle pressure, the wound healed without the slightest formation of pus, and there was very little soreness. There was no mutilation of the interior of the nose, for even directly after the operation it was difficult to detect, by simply inspecting the interior of the nose, the incision that had been made. In a few days the nose was entirely healed, and the soreness had disappeared when the patient left for her home.

While Roe indubitably was the first to employ the endonasal route, credit for the elaboration of the technique is due to Joseph, who may therefore rightly be considered the father of modern corrective rhinoplasty.

To turn now to the present, in 1951 we[7] described a method whereby the resiliency of the cartilages is eliminated and they are shaped with the fingers like a piece of clay, the form being maintained with adhesive strips, which act as a mold wherein the tissues heal in a manner similar to the congealing of gelatin poured into a container.

At the time we were convinced that we had discovered a new technique. In reviewing Roe's article[5] of 1887, we find that he antedated us by 64 years. He wrote as follows:

These noses can be very readily moulded into a handsome shape by cutting, with a small tenotomy knife, through these cartilages [lower laterals], in different places, sufficiently to destroy their elasticity. Then by inserting a silver or hard-rubber tube, of the proper size and shape, into the nostril, and conforming the saddle to the outside of the nose, we have it encased in an outside and inside splint that compels it to conform to the exact shape we desire.

How our medical predecessors steal from us!

Joseph's orthopedic discipline led him to view the nose as a solid, rigid, inelastic body, which could be cut and joined with the greatest accuracy. On this assumption he elaborated a technique so perfect that, with minor modifications, it remains the standard today for those who adhere to his concept. The rules he laid down for the rigid parts, however, are inapplicable to the soft structures, inasmuch as soft tissue contracts on healing, and scars stretch when subjected to weight. As a matter of fact, his procedure of first modeling the hard structures and then shaping the soft parts to harmonize with them precludes the possibility of laying down rules for the management of the soft parts. This had to be learned by prolonged trial-and-error experience—a price too high for the rhinologist. And this, we believe, is the principal factor which prevented the operation from becoming one of general utility.

Let us now introduce the rhinologic concept, which owes its inception to a small group of rhinologists who fell under the spell of rhinoplastic surgery. This same spell gave rise to a missionary devotion to share their knowledge with others and to seek incorporation of the procedure into their chosen field. Like all pioneers, they found the going "uphill." Some of their colleagues were but mildly interested, others sceptical, and still others actively opposed, seeing no place for a plastic operation in the practice of rhinology. In time, however, these zealous enthusiasts, under the aegis of Coates, of Philadelphia, Lierle, of Iowa City, and Brown of Los Angeles, either wooed the opposition to their cause or compelled sympathetic attention. Gradually their numbers increased, and to broaden their knowledge, they met in informal seminars, pooling their experience and exchanging opinions. Views previously accepted by a generation of rhinoplastic surgeons were subjected to a searching scrutiny, with the result that old beliefs were modified or discarded. This took time. According to Nicholson,* "When a tradition once becomes established by the hallmark of acknowledged authority, it takes more than cold facts to uproot it from men's minds—It takes time."

With many minds focused on a single objective, the rhinoplastic operation was transformed from a purely empiric procedure into a meeting ground for anatomy, physiology and rhinology. Whereas formerly unfavorable results were corrected by a modification of the procedure, an attempt was now made to eliminate them at the very start by a reorientation in thinking. New ideas came into being, and these in turn led the way to a more rational approach. The soft parts and the full thickness of the cartilage were no longer sacrificed but rather reassembled and molded after their elasticity had been reduced by shaving and/or cross hatching. For the first time definite rules could be laid down for the beginner and thus much of the trial and error eliminated. It might be said that where Roe and Joseph ended a chapter in rhinoplasty the rhinologists, in their effort to make the operation one of general utility, opened a new one.

Perhaps we can best bring out the differences between the orthopedic and rhinologic procedures by comparing them in parallel columns:

* Nicholson, W., quoted in Robertson.[8]

Orthopedic Method	Rhinologic Method
Shortening of Nose	
Concept	Concept
The required amount of shortening is determined by the relation between the vertical length of the face and a line drawn from the nasal root to the tip. Ideally, the nasal length should constitute one-third of the facial length.	The required amount of shortening is determined by the inclination of the nares. Thus if the nares form an angle with the lip of 90 to 95 degrees in men and 100 to 110 degrees in women (assuming that the lip is normal), the nose has been adequately shortened, irrespective of the length from root to tip.

Technique

Shortening is accomplished by the excision of a triangle from the septum and upper lateral cartilages. The lower segment is tilted into the space thus created. Two strong sutures hold the parts in an overcorrected position.

Results

1. The thin marginal adhesion between the upper and lower segments gives no assurance against postoperative drooping. As a result, further shortening is required in about 10% of all cases.

2. A retraction of the columella will result, with an accompanying snubbing or convexity of the tip, when the length is due to the nasal bones and/or upper lateral cartilages.

3. A pinched appearance sometimes results from bringing into apposition an upper and a lower pyramid of unequal sizes.

4. A natural inclination of the columella is difficult to obtain.

5. The exact amount of cartilage to be removed cannot be determined, because it is impossible to predict the subsequent contraction and the extensibility of the membraneous septum.

Faults

No rules can be laid down as to the amount of skeletal tissue to be removed. This can be learned only through trial and error.

Technique

Shortening is accomplished by the telescoping of the lower cartilaginous vault over the upper, in a manner similar to that raising the visor of a 14th century helmet. The broad adhesion eliminates the need of sutures.

Results

1. The adhesion resulting from the broad overlap eliminates postoperative drooping.

2. The various lengths of the nasal components do not affect the result.

3. A pinched appearance is eliminated.

4. A natural inclination of the columella is easily obtained.

5. Precise trimming of the cartilage is possible, since the amount to be removed is determined after shortening, and the excess is resected as an overlap.

Faults

Definite rules can be laid down as to the amount of skeletal tissue to be removed. Trial-and-error experience is thus largely eliminated.

Lobular Corrections

Concept

Lobular defects are considered as due to faults in bulk of the lower lateral cartilages.

Technique

Correction is obtained by a sacrifice of full-thickness cartilage. For instance, to narrow a wide tip, sections are removed from the angles; to reduce bulbousness, the cephalic margins of the lateral crura are trimmed; to lessen undue projection, cartilage is resected from the mesial and/or lateral crura.

Results

Healing of the deskeletonized lobule is not always predictable, and because of this there frequently results a pinched surgical look.

Faults

No rules can be laid down as to the amount of cartilage to be removed. This can be learned only from trial-and-error experience.

Concept

Lobular defects are considered as due to faults in shape rather than to the bulk of the cartilage.

Technique

The resiliency of the cartilage is eliminated by shaving and/or cross hatching, and the lobule is molded like a piece of clay, its shape being retained by splinting. It is thus allowed to heal in a manner similar to the congealing of gelatin poured into a container.

Results

Healing of the lobule is predictable, as the full thickness of the cartilages is not removed, and a pinched surgical look is thus obviated.

Faults

Rules as to the amount of cartilage to be removed are not necessary, since the lobule is molded like a piece of clay.

Narrowing of Nose

Concept

Following the hump removal, the nose is viewed as being too broad.

Technique

To correct the broadness, osteotomies are performed through the frontal processes of the maxillae, and the lateral walls are shifted medialward.

Concept

Following the hump removal, the nose is viewed not as being too broad but as a conversion of a cross sectional triangle into a trapezoid.

Technique

To reconvert the trapezoid into a triangle, the lateral walls are mobilized by an osteotomy through the frontal processes and tilted medialward, without a disturbance of the basal relationship.

Faults

The space left on either side as a result of the shifting tends, in the process of ossification, to cause a recurrence of the broadness; to prevent this, a nasal splint is applied.

Hump Removal

Concept

The soft parts are modeled to harmonize with the hard parts. Thus the hump is removed first, and the amount to be excised is measured by an angle formed between the vertical length of the face and the nasal dorsum and is marked out on the photograph, cast and the patient's skin.

Results

Either too little or too much of the hump is removed.

Faults

It is difficult, if not impossible, to gauge the amount of hump to be excised before shortening. To place a mark on the skin, photograph or cast is of little practical utility to the novice, who loses all orientation as soon as the saw is placed beneath the skin. He must learn through trial-and-error experience.

Faults

No space being left on either side, there will be no tendency to lateral displacement of the walls and no need of a splint.

Hump Removal

Concept

The hard parts are modeled to harmonize with the soft parts. Thus the hump is removed last, and the amount to be excised is measured by a line from the apex of the pyramid to the nasal tip.

Results

An accurate gauge is furnished as to the amount of bone and cartilage to be removed.

Faults

The amount of hump to be excised can be accurately gauged. (While nasal shortening, modeling of the lobule, and narrowing of the nose have been reduced to a point where trial and error is eliminated and these procedures can become of general utility to the average rhinologist, the same cannot be said of hump removal. The technique here is simple. The difficulty lies in the creation of a subcutaneous landmark for the cutting instrument. We have driven pins into the nose to serve the same purpose as does a carpenter's miter box, but without success. At present we are experimenting with fragmentation of the bony structures, followed by modeling of the dorsum. Not enough time has elapsed for a proper evaluation of this procedure.)

SUMMARY

In the orthopedic rhinoplasty all corrections are made by the excision of skeletal tissue, with the consequent penalty of asymmetrical healing of the overlying soft parts. Thus a nose well modeled at the end of surgery too often months later will appear less satisfactory. Furthermore, no accurate rules can be laid down as to the amount of skeletal tissue to be removed. Thus success is possible only as a result of prolonged trial and error. Finally, the adhesions formed between the marginal contacts of the upper and lower segments are not sufficient to prevent postoperative drooping of the tip. The principal benefits of the rhinologic method are the following: All corrections are made with a view of reassembling the nasal elements rather than of sacrificing their substance, and accurate rules can be given to obtain the desired results. The adhesions formed between the upper and lower segments are sufficient to prevent postoperative drooping. The sequence of operative steps is changed: Whereas formerly the soft parts were modeled to harmonize with the hard parts, now the soft parts are modeled first.

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Audiology Section

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Instruments for Measuring Sound

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SCOPE

It is the purpose of this paper to cover briefly the basic characteristics of sound as they dictate the design of instruments. The discussion of the equipment will be confined to available commercial instruments, and stress will be given to those instruments which are particularly useful for field evaluation of noise problems as they relate to industrial hygiene.

NATURE OF SOUND

Sound has been defined by the American Standards Association [1] as "an alternation in pressure, stress, particle displacement, particle velocity, etc., which is propagated in an elastic material, or the superposition of such propagated alternations." In the case of industrial noise, the elastic medium is air and the alternations in pressure are variations above and below atmospheric pressure. Atmospheric pressure under standard conditions is 1.01325×10^6 dynes per square centimeter. The pressure variations with which we are concerned in sound have an approximate range of 0.0002 to 2000 dynes per square centimeter.

This type of sound is a wave motion (Fig. 1) set up in air by a vibrating body—the source. The vibrations move particles of air which transmit the motion to an adjacent group of air particles, and so on, producing a wave motion. This wave motion may vary in amplitude (the amount of air particle movement) and in frequency (the number of alternations per second).

There are in such a system several quantities related to the amplitude of the sound wave which are interconnected.

1. Sound pressure is the deviation of atmospheric pressure from normal at any instant of time. This

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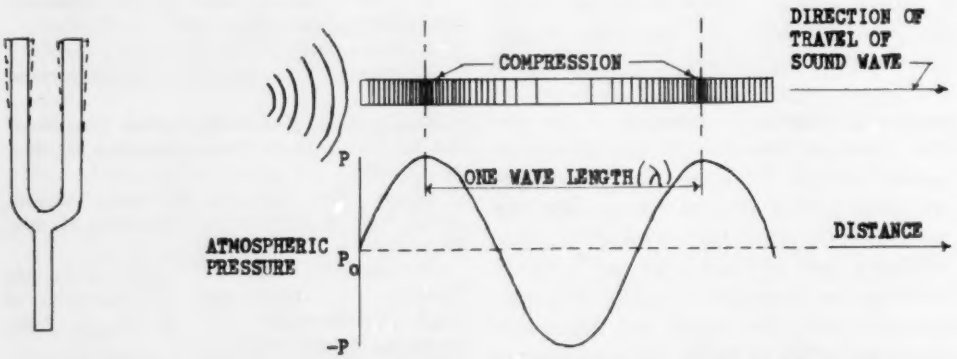

Fig. 1.—Plot of sound waves showing relation between sound pressure versus distance at one instant of time and sound pressure versus time at any fixed distance from source (modified from Pietrasana).

fluctuation above and below normal may be characterized by a description of the peak or root-mean-square value. The units are portions of atmospheric pressure: microbars, or dynes per square centimeter.

2. Sound energy is the potential ability of a volume of air to do work as a result of a sound wave. For most practical situations, the sound energy is proportional to the square of the sound pressure. It may be expressed in terms of ergs.

3. Sound power is the rate at which sound energy flows from one place to another. It may be expressed in terms of watts. It is proportional to the speed of sound (ca. 1120 ft. per minute) times the sound energy.

4. Sound intensity is the amount of sound power that flows through a certain unit of area. This quantity may be expressed in terms of watts per square centimeter or watts per square meter.

The range of sound intensities with which we are dealing is so extreme that it would be difficult to work with watts per square centimeter. Thus a decibel scale is used. The decibel is a dimensionless term used to express the logarithm of a ratio. It can be used to express the ratio between two powers, intensities, or pressures. In the case of the usual sound-measuring quantities, the decibel is proportional to the logarithm of the ratio between any power, intensity, or pressure and a reference power (10^{-13} watts), intensity (10^{-16} watts per square centimeter), or pressure (0.0002 dynes per square centimeter). In all such cases the results are expressed as a "level"—sound power level, sound intensity level, or sound pressure level. The use of the term decibel, therefore, requires statement of the reference term in order to establish whether power, intensity, or pressure is being referred to.

These relationships may be expressed as follows:

Sound intensity level in decibels

$$10 \log_{10} \frac{I}{I_o}$$

I=sound intensity (watts/cm.^{2})
I_o=reference sound intensity, 10^{-16} watts/cm.^{2}

Sound pressure level in decibels

$$20 \log_{10} \frac{p}{p_o}$$

p=sound pressure (dynes/cm.^{2})
p_o=reference sound pressure, 0.0002 dynes/cm.^{2}

Thus in sound pressure levels, which are the values obtained with a sound level meter, the decibel is proportional to the logarithm of the ratio of measured to reference pressures. A tenfold increase in pressure is equal to 20 db.; a hundredfold increase is equal to 40 db.; a thousandfold increase is equal to 60 db., etc. A sound level meter, therefore, must be capable of operating over a wide range of sound pressures—about 10^6 to 1 (a million to one).

The frequency of a sound refers to the number of alternations of the sound wave per unit time (Fig. 1). This is expressed as the number of cycles per second. The simplest kind of sound is a pure tone, whose frequency corresponds to the number of times per second that the pressure goes through a complete oscillation about atmospheric pressure. The time-frequency relationship is inverse, as shown by the formula

$$f = \frac{1}{T}$$

where

f=frequency in cycles per second
T=period in seconds

The relation between frequency, wave length, and velocity is as follows:

$$\lambda = \frac{c}{f}$$

where

λ=wave length in feet
c=velocity of sound in feet per second
f=frequency of sound in cycles per second

It can be seen from this formula that wave length varies inversely with frequency. A 1000 cycle tone thus has a wave length of 1.1 ft.; a 100 cycle tone, 11 ft.

Pure tones, however, are not present as industrial noise. A noise is made up of unrelated frequencies, having different sound pressures. This, of course, complicates the problem of noise measurements, requiring a fundamental decision as to the detail required in frequency analysis.

SOUND LEVEL METERS

The basic instrument for measurement of noise is the sound level meter (Fig. 2). This meter consists of a microphone which reacts

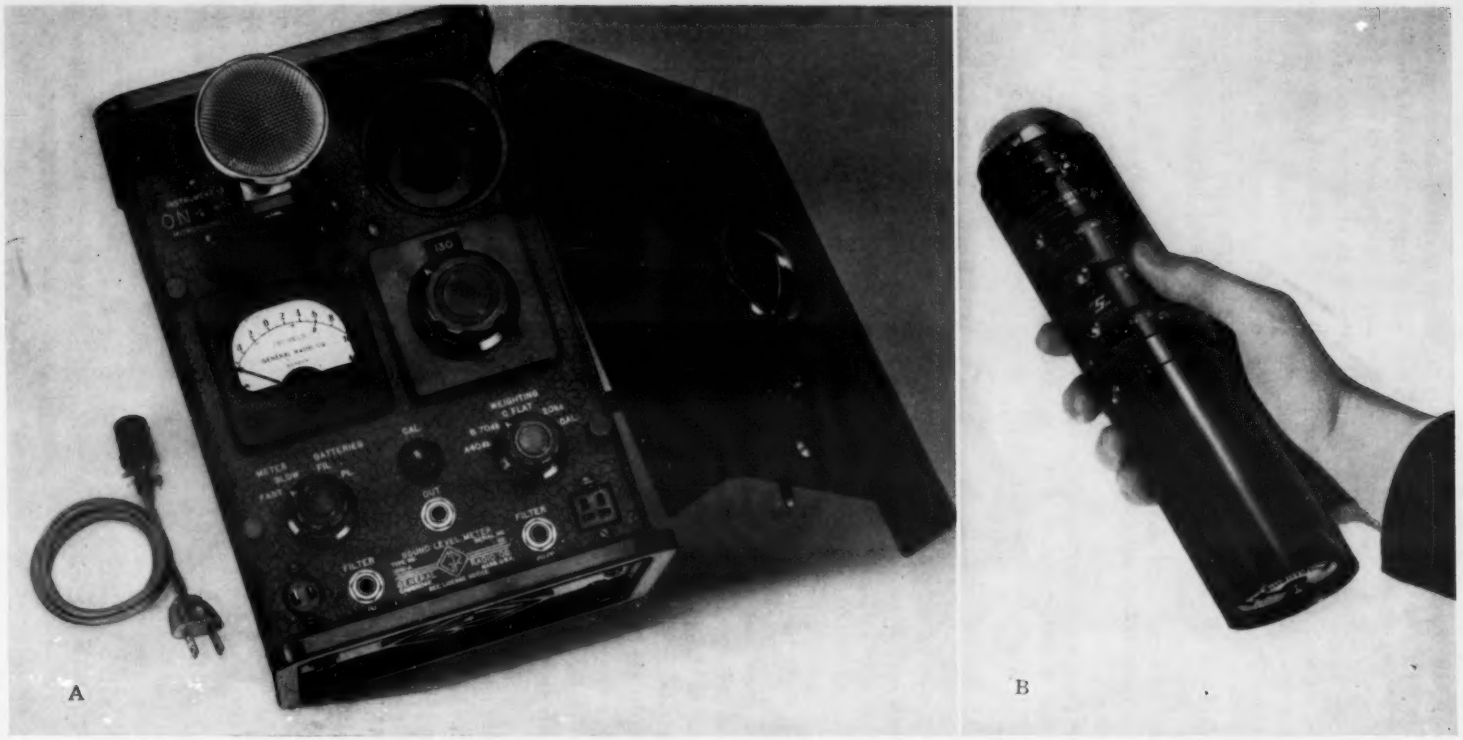

Fig. 2.—Sound level meters (courtesy of General Radio Company and H. H. Scott Company).

to sound and produces an electric current which is fed into an electronic circuit consisting of an attenuator, amplifier, a series of frequency response networks (weighing networks), and a meter. The development of this equipment has taken place during the past 20 years. The important improvements have come about as a result of the application of subminiature tubes, hearing aid batteries, and printed circuits, resulting in the development of sound level meters which are more reliable and considerably more portable than their predecessors. At the present time considerable effort is being expended in improvement of microphones.

As has been pointed out previously, the sound level meter is designed so that the reading obtained is the root-mean-square (the square root of the sum of the squares of the weighted sound pressures of the various single frequency components of the complex wave) sound pressure level expressed as decibels re 0.0002 dynes per square centimeter.

Available sound level meters have responses in the range between about 20 to 15,000 cps and 20 to 180 db. (re 0.0002 dynes per square centimeter), depending on the microphone used.

Design criteria for sound level meters have been developed by the American Standards Association.[2] They permit large tolerances, particularly at high and low frequencies. Calibration of each instrument at several frequencies is, therefore, essential. Specifications for performance of all components of sound-measuring equipment are also included. How the manufacturer accomplishes compliance is limited only by his ingenuity.

The various components of a sound level meter—the microphone, attenuator, amplifiers, weighing networks, and meter—are all important, as is the circuit, in determining the quality of response. Likewise, each is a potential source of error.

MICROPHONES

The microphone is by far the most important single part of the equipment, since the quality of the final result can be no better than the signal produced by the microphone. ASA Z24.8[3] defines a microphone as "an electroacoustic transducer which responds to a sound wave and delivers a substantially equivalent electrical signal." The function of the microphone is to pick up sound energy and convert it to electrical energy, which is then fed into the electronic circuit.

The sensitivity, frequency response, range, and directionality of sound level meters are primarily dependent on the properties of the microphone used. Its importance cannot be overemphasized.

At the present time there is no perfect, all-purpose microphone available. There is a wide variety of microphones for special purposes. These range from those used in telephones, in which requirements of frequency response, sensitivity, and freedom from internal noise are minimal, to special microphones for research studies, where precise evaluations are required under a limited set of conditions.

In general, microphones for sound level meters are selected on the basis of sensitivity, wide frequency response, minimum self-noise, availability, uniformity, and cost. In all cases to date, compromise has been necessary. Most sound level meters presently available are supplied with crystal microphones, but, in most cases, other types can be obtained as accessories.

There are three major types of microphones currently in general use for the measurement of sound. Each has its advantages and disadvantages, and selection must be made on the basis of the requirements of the job to be done.

Crystal Microphones

There are three types of crystal (piezzoelectric) microphones—Rochelle salt, barium titanate, and ammonium dihydrogen phosphate—but only the Rochelle salt is widely used. This microphone is supplied as standard equipment on practically every sound level meter sold today. The reasons for this are its high sensitivity, availability, low cost, and ruggedness. It has a particularly good low-frequency response.

The frequency range is from about 20 to 8000 cps. Its frequency response varies widely with the incidence of the sound. Octave band levels can be measured as low as 20 db. and as high as 150 db.

One disadvantage of this type of microphone is its sensitivity to heat and humidity. Temperatures above 125 F will destroy the crystal. In addition to this, there is a reversible change in sensitivity of the crystal produced by temperature change. When a cable is used and the input impedance of the amplifier is high, a temperature correction is necessary. It can be noted that the correction curve is extremely complex in the region of normal room temperatures.

When excessive cable is used, the loss in the cable reduces the sensitivity to a point where the advantage of using a crystal microphone is lost. The dividing line is of the order of magnitude of 200 ft. of cable.

Among the important disadvantages of the Rochelle salt crystal microphone is its erratic high-frequency response and high directionality at high frequencies. It should be pointed out further that basically this is not a low noise microphone. The self-noise is higher than the equivalent noise of a dynamic microphone. If lower background noises are to be measured, a dynamic microphone should be used.

Dynamic Microphones

The dynamic microphones operate on the principle of a coil moving in a magnetic field, resulting in an induced voltage. They have a dynamic range of 20 to 140 db. and a frequency response of 40 to 8000 cps ± 5 db. They have less erratic high-frequency response than crystal microphones, but the low-frequency response drops off sharply below 40 cps. Because of this, not much confidence should be placed in values in the 20 to 75 cps band if analysis is made using a dynamic microphone. Its directionality is about the same as the Rochelle salt crystal microphone.

These microphones have the advantage of low self-noise, permitting measurements down to less than 20 db. in an octave band. Their temperature sensitivity is small (up to 180 F), and they can be used with long cables without correction. Care must be taken, however, to avoid getting these microphones wet, because of the possibility of internal short circuit. In addition, they cannot be used in strong magnetic fields, such as those around power stations, transformers, cyclotrons, and radar antennas.

Condenser Microphones

The condenser microphones consist of two plates which act as a condenser. One is a thin diaphragm; the other, a solid backing. Movement of the diaphragm by sound pressure changes the capacitance of the condenser proportionally to the displacement of the diaphragm. This is the most expensive type of microphone, but it shows promise of being the most versatile.

Because of its high output impedance (Altec 21-C=about 6$\mu\mu$f), it is necessary to provide a high input impedance preamplifier located close to the microphone.

These microphones have the best frequency response of all currently available types. The frequency response is essentially flat from 20 to 8000 cps and remains within ± 3 db. to 14 kilocycles. The high-frequency effects of directionality are also the least of the three microphone types. The dynamic range is from 50 db. to almost any pressure level desired up to about 180 db. in special models. The standard model has a maximum of 140 db.

The temperature sensitivity corresponds to that of dynamic microphones. They can be used at much higher temperatures, since only the preamplifier is the limiting factor. In addition, they can be used with moderately long cables without correction and are not injured by rapid changes in altitude.

The disadvantages are related to cost, self-noise, humidity effects, additional electronic complexity, and vibration sensitivity of the preamplifier under certain conditions. Because of relatively high self-noise, measurements cannot be made below 50 db. This can be compared with 20 and 24 db. for dynamic and crystal microphones. High humidity may increase internal noise, but this can be remedied by desiccation.

Condenser microphones are relatively new, and there has been little field experience with them to date. They hold much promise, however, of solving many of the problems inherent in crystal and dynamic microphones.

ELECTRONIC COMPONENTS

The electrical output from microphones, in the range of sound levels from 24 to 144 db., covers an extremely wide range, from about 3μv to about 3 volts. This signal must be amplified at the low end of the scale and attenuated at the upper end of the scale, since the amplifier can handle only a range of the order of magnitude of 20 to 30 db. at one time. Therefore, the attenuator permits us to utilize a condensed meter scale covering only about 16 db. Thus, the extreme range of voltage can be handled by the attenuator plus the meter scale. In other words, as the sound gets louder, the output of the microphone is attenuated so that the signal to the amplifier is always in the same range. In present commercial sound level meters, attenuation is usually in 10 db. steps.

The frequency response of sound level meters is usually stated to be 20 to 10,000 cps. Actually, the response is determined by the type of microphone used. Because of variations in human response to frequency, as shown by the Fletcher-Munson curves [4] (Fig. 3), sound level meters are usually provided with a series of three "weighting networks." The frequency response curves for these three networks are shown in Figure 4. The intended function of these networks is to modify the instrument response so that it will approximate human response, as shown by the Fletcher-Munson curves.

These curves are based on studies of human reaction to pure tones of several frequencies. The subjects were asked to judge the loudness of tones of the various frequencies as compared with the loudness of a 1000 cycle tone at various intensity levels. The results indicate that at sound intensity levels of the order of magnitude of 90 db. or above all frequencies were judged by the subjects to be about equally loud. This response at these levels is said to be "flat." The "C-network" on the sound level meter thus provides a flat response for all frequencies. This network is intended to be used at levels of 85 db. and above. At low intensity levels the ear response is less at low frequencies. For example, a 61 db. 100 cycle tone is judged to have the same loudness level as a 40 db. 1000 cycle tone. The "A-network" on a sound level meter represents this response and is intended for use when the sound level is about 40 db. The "B-network" provides a response corresponding to an intermediate situation between 40 and 85 db. and is intended for use at sound levels of the order of magnitude of 70 db.

It can be seen that one important limitation of sound level meters for noise measurement is their failure to reproduce accurately the human response to noise. One purpose of the ASA Standard [2] is to provide specifications which will give an approximation of total loudness level. The A, B, and C networks are intended as a means of accomplishing this. As may be seen from the Standard, however, present meters approximate loudness level only in the case of pure tones. If the sound is more complex, the loudness level must be computed by adding the components, using the relation between loudness and loudness level.[3]

Indicating meters on available sound level meters are all provided with a dial having a 16 db. range and both slow and fast responses.

The meter is the component of sound level meters which limits their use in measuring accurately impact noises of short duration. This is because of meter lag in responding to noise peaks having a duration of less than about 0.1 second. The meter is calibrated to indicate root-mean-square. Because of this and meter lag they do not indicate peak values. Other methods must be utilized to evaluate peak values of impact noise of short duration, such as that from drop hammers, single gunshots, and power presses.

One manufacturer has introduced a new battery-operated peak reading voltmeter which will be available as an accessory to be attached to standard sound level meters. Its

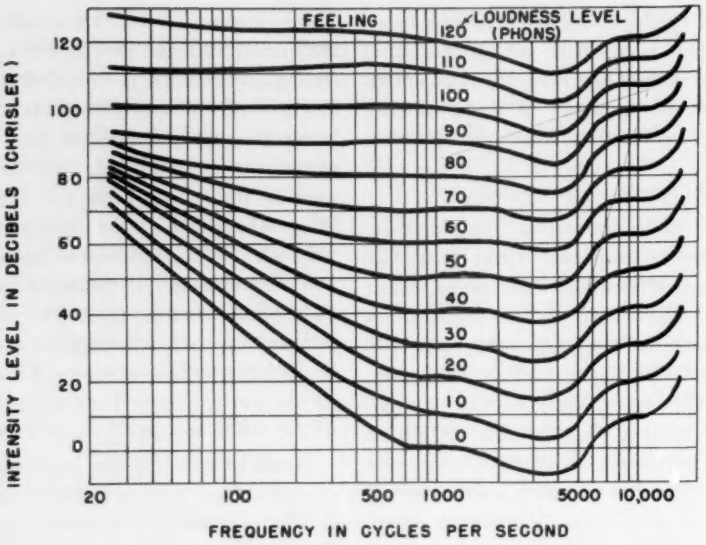

Fig. 3.—Fletcher-Munsen curves: contours of equal loudness.

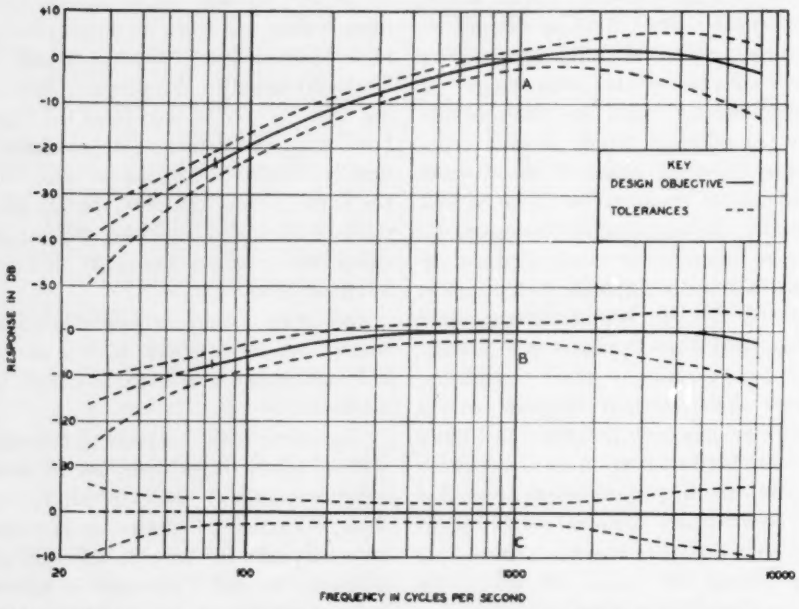

Fig. 4.—Design criteria: over-all free-field response for sound level meters together with tolerances permitted. (Courtesy American Standards Association Z24.3-1944.)

characteristics are described in another paper, given at a University of Michigan symposium.[6]

CALIBRATION OF SOUND-MEASURING EQUIPMENT

Periodic calibration of sound-measuring equipment is absolutely essential if valid data are to be obtained. Calibrations can be made on the electronic circuit of the instrument alone or on the entire instrument, including the microphone. The first type of measurement is the simplest and should be made frequently, since it provides, among other things, a means of correcting for loss of

power from weak batteries. This is particularly important when the instrument is used continuously for long periods of time. Electrical circuit calibration consists of introducing a 110 volt 60 cycle signal directly into the circuit to standardize the gain of the amplifier in relation to the attenuator, which is always calibrated by the manufacturer. It should be emphasized that this calibration does not include the microphone.

Microphone calibrations are considerably more complex. There are, in fact, very few laboratories which can provide complete calibration at all frequencies. Those who use sound-measuring equipment must depend on the microphone and instrument manufacturers for primary calibrations. There are available commercially, however, so-called calibrators which provide for single frequency checks on the response of sound level meters, including the microphone. These calibrators consist of a transistor oscillator and a small stable loud speaker in an enclosure to fit over the microphone. The transistor oscillator supplied by one manufacturer provides two single frequency signals, one at 400 and one at 1000 cycles. The output is adjustable so that the voltage can be controlled. The loud speaker operates at an input of 2.0 volts, and is said to provide a sound pressure level of 85 ± 1 db. (re 0.0002 microbar*).

A new type acoustic calibrator has been introduced by H. H. Scott. It has been designed to approximate the ASA Standard for sound level meter calibration.[2] It consists of a stable loud speaker and noise generator which introduces a spectrum which is said to have the proper shape from under 100 to over 2000 cps. It will be supplied with adapters to fit all microphones now available.

NOISE ANALYSIS

As has already been pointed out, noise consists of a group of unrelated sound frequencies with many different sound pressures. The sound level meter provides values of the total sound pressure level of all of the frequencies within the range of the microphone used. In industrial noise work, whether for purposes of estimating the potential hazard to hearing or obtaining data for noise control, it is usually necessary to have more detailed data on the distribution of sound energy in bands which are narrower than the full response of the microphone. There are several kinds of analyzers available, utilizing the output of sound level meters, which can be used to obtain this information. Since the analyzers operate on sound level meter output, the validity of these data is dependent on the microphone and sound level meter response.

Analysis of noise can be made by the use of either electrical filter sets or cathode ray oscilloscopes. Electrical filter sets may be classified as either constant band width or proportional analyzers.

Constant band width analyzers have little value in noise measurement for industrial hygiene purposes for many reasons. They are essentially laboratory instruments, requiring line voltages for operation, which provide a measure of the sound energy in narrow frequency bands—ranging from 5 to 200 cps. In order to cover the spectrum from 20 to 10,000 cps by 5 cps bands, nearly 2000 readings would be required; even in 200 cps about 50 readings would be required to make one analysis. An even more serious limitation is related to the transient nature of many of the components of industrial noise. Within a given band, individual frequency components of the noise may shift through the band being measured. This results in a continuing and wide fluctuation in the meter. For this reason, it is almost impossible to obtain a reading with this type of instrument on an industrial noise.

There is also a constant percentage narrow band analyzer in which the band width varies with the frequency being measured. One commercial model (General Radio 760-B) has a range from 25 to 7500 cps in five steps. Each range is tuned separately. Band widths in this model are ± 1.5% of the frequency to which the dial is set or ± 1.5 cps, which-

* One microbar is equal to 1 dyne per square centimeter.

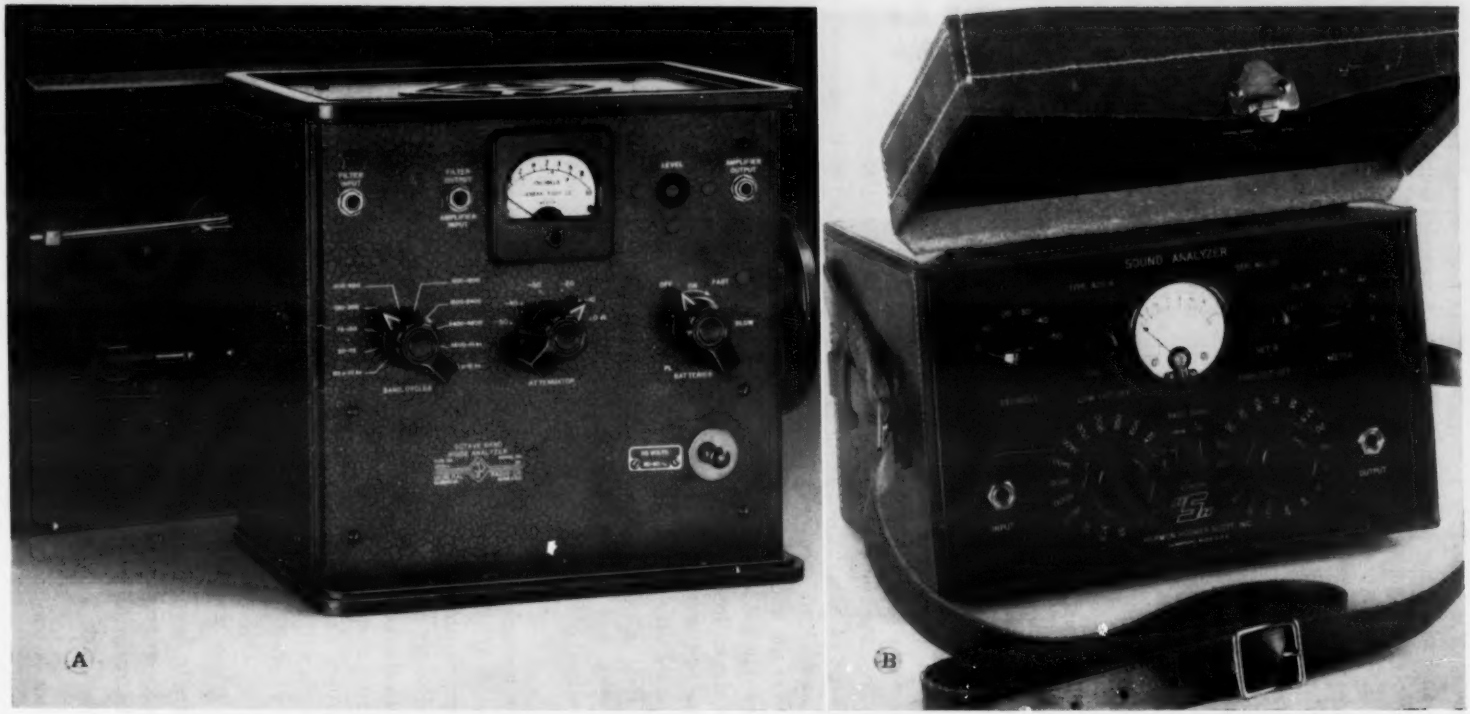

Fig. 5.—Octave band analyzers (courtesy of General Radio Company and H. H. Scott Company).

ever is larger. This instrument is subject to the same meter fluctuation as the constant band width analyzer and, therefore, of little use in routine noise analysis.

The most practical and most widely used analyzer for industrial noise is the octave band analyzer (Fig. 5). This analyzer is usually provided with a low pass filter (below 75 cps), a high pass filter (above 4800 cps), and six filters, each of which passes an octave (75 to 150, 150 to 300, 300 to 600, 600 to 1200, 1200 to 2400, 2400 to 4800 cps). This analyzer provides sufficient data on industrial noise to evaluate the physiologic significance and to give a basis for engineering control. The small number of bands makes it possible to complete an analysis in a reasonable length of time, and the bands are wide enough to reduce the problem of transient components affecting the stability of the meter readings.

The General Radio octave band analyzer is designed to be operated on the output of a sound level meter. It consists of eight band-pass filters with a switch for selection of bands or over-all (20 to 10,000 cps), an attenuator, an amplifier, and a meter. There is also a rheostat for adjusting the meter on the analyzer so that it corresponds with that on the sound level meter when the analyzer selector switch is set on the over-all position. The attenuator, which is 50 db. in 10 db. steps, and the amplifier serve the same function as they do in the case of the sound level meter, to keep the voltage input within a range which can be handled by the amplifier. The meter has about a 16 db. range. The values obtained are the sum of the sound level meter attenuator reading, the analyzer attenuation, and the analyzer meter reading.

Another analyzer of this type has a set of filters which extend one octave lower and one octave higher than the ASA Standard.[7] There are two controls for separate adjustment of the low frequency cutoff and high frequency cutoff in the range from 37.5 to 9600 cps in one-half octave steps. Additional steps are provided on each control to cut the filter out. A gear shift is provided so that the two control dials can be locked together in any desired ratio (band width). Thus if the dials are set an octave apart and locked, the bands may be shifted in one octave steps. Similarly, band widths of one-half octave or multiples of one-half octave may be set up.[8]

A third kind of analyzer has 13 overlapping octave bands. It consists of high and low pass filters spaced approximately an octave apart, covering the range 50 to 4800 cycles. The two end bands provide 20 to 50 and 4800 to 15,000 cycle pass bands. The actual range, however, will be determined by the microphone used. Band selection is obtained by means of a multiple push-button switch. In addition to the bands, a selector switch is provided which disconnects the filter sections and permits over-all measurements.

Most octave band analyzers are equipped with an output jack, permitting the use of headphones, recorders, narrow band analyzers, or oscilloscopes in combination with the sound level meter and octave band analyzer.

Two manufacturers are proposing to introduce new instruments consisting of a sound level meter and an octave band analyzer in a single case.

One company is planning to introduce an industrial noise meter and an octave band analyzer in a single case. It will be supplied with both rms and peak reading voltmeter which read simultaneously. It will be 110 V. AC operation.

Use of a cathode ray oscilloscope permits observation of the wave form of a noise. It is particularly useful in evaluating impact noises when the meter response of sound level meters is too slow to give a valid result. In general, the oscilloscope is a laboratory instrument, but it can be used in the field, if necessary.

There is a confusing variety of kinds of oscilloscopes available. There are, however, a few characteristics which are desirable in an instrument to be used for industrial noise work. A long persistence 5 in. screen should be used if pictures are to be taken, so that sufficient detail can be obtained for measure-

ment. In addition, the only facilities currently available for photographing oscilloscope images are adaptable to 5 in. screens. The instrument should be provided with a synchronizing input to permit a properly centered image in the case of impact noises of short duration. In addition, it should have a slow sweep. An adapter and Land Camera are useful, since this permits immediate development of film and retake, if necessary. The main disadvantage of this arrangement is the poor quality of duplicate prints. Finally, from the practical point of view, particularly if the oscilloscope is to be used in the field, it should be rugged and well built for stability and to facilitate maintenance. In order to obtain quantitative results a calibrated sound source must be used to calibrate the oscilloscope screen.

RECORDERS

It is frequently desirable to have a record of industrial noise, particularly for detailed laboratory study or for analysis of intermittent noise. The magnetic tape recorder, which preserves a complete electrical reproduction of the sound waves, and the graphic level recorder, which provides a tracing on a moving strip of paper which corresponds to the movement of the meter needle, are the two most important types.

For industrial hygiene work the magnetic tape recorded is by far the most versatile, since it permits bringing the noise into the laboratory for detailed and repeated study. The graphic level recorder, on the other hand, is subject to the same failings as the sound level meter in the analysis of noise of short duration.

The requirements for a tape recorder for this type of work are stringent. The frequency response must correspond to the range which can be measured with the sound level meter (20 to 10,000 cps). In order to record frequencies up to 10 KC a speed of 15 in. per second is essential. This is a fundamental limitation resulting from the recording head geometry and the minimum space required to reproduce a sine wave on the tape. The dynamic range must be better than 35 db. over the entire frequency range of interest. It is desirable that the dynamic range be about 50 db. in the high frequency region. This rules out nonprofessional recorders, because a satisfactory dynamic range is achieved only in the middle frequency range, if at all. Equipment meeting these requirements at the present time is expensive, cumbersome, and heavy. There are developments, however, in the precision recorder field which are expected to produce portable instruments which will be more adaptable to industrial noise work.

MISCELLANEOUS

It should be pointed out that most of the sound level meters and analyzers which have been discussed are battery-operated. This is highly desirable from the standpoint of portability and general field use, but it has not been accomplished without some sacrifice in certain operating qualities. There are available adapters for AC power operation. These have the advantage of increased stability, since variations in battery voltage are eliminated. However, other fundamental disadvantages of battery equipment, such as low amplification and poor dynamic range, can only be overcome by complete redesign of the equipment for AC operation.

Any discussion of instruments in a field as new to industrial hygienists as this would be incomplete without mention of the great value of the manufacturers' operating and maintenance instructions. They should be thoroughly read and understood before any instrument is used. This will prevent many difficulties which are frequently encountered by new users of the equipment. In addition, the manufacturers are always glad to give all information required to assure the best possible performance of the equipment which they sell. If the new user of noise-measuring instruments follows the manufacturers' instructions, his problems will be minimal.

COMMENT

Instrumentation in the industrial noise field is in its infancy. Development of better instruments will come from use and intelli-

gent evaluation of present instruments. As weaknesses are found and reported, they will be overcome. Present research and development in improving microphones, calibration techniques, and measuring impact noise have all resulted from the rapid expansion of the use of noise-measuring equipment under the impetus of the industrial noise problem. The same stimulus resulted in the formation of the Z24-W.18 Committee of the American Standards Association to attempt to improve the design criteria for sound level meters. The instruments discussed here are today's models—the quality of tomorrow's will depend on your demands.

The instrument manufacturers supplied information, drawings, and photographs.

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Case Reports

OPEN SAFETY PIN IN THE ESOPHAGUS OF A SEPTUAGENARIAN

Report of Successful Removal With a Magnet

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THE INFANTILE propensity to put things in the mouth, especially open safety pins, has long been recognized, and much has been written of the importance of prompt removal of the pin and of various methods of retrieving it. Once a person is past the diaper age, however, the safety pin is not so much in evidence, and one is apt to forget that even elderly persons, who should know better, put them into their mouths and sometimes swallow them. A closed safety pin is of no consequence, and it may safely be counted on to pass uneventfully through the viae naturales. A probable explanation of the way in which elderly people swallow such a pin is that, since they wear upper dentures, the sensitiveness of their natural teeth to foreign bodies is gone and the sensation of the hard palate is masked by the plate.

The technique of removing a safety pin from the esophagus of an elderly person differs in no important detail from that employed in the case of a small child. When an open safety pin is swallowed, it must of necessity go down with the ring leading. To bring it back immediately would obviously tear the esophagus; indeed, it would be impossible. One has several choices then: It is possible to cut the pin so that it may be brought back in two pieces; it is possible to close the pin in the esophagus; one may secure the passage of the pin into the stomach. If the stomach is inflated, one can then reverse the pin and bring it back up the esophagus by the ring, with the point harmlessly trailing.

Fig. 1.—Open safety pin in lower third of the esophagus.

The first two procedures present many technical difficulties. To carry out the third, we employ an Equen magnet on a semiflexible mount with a tube attached to a hand bellows. In this way, provided only that the pin is of steel and that one has a fluoroscope, it is a simple matter to introduce the pin into the stomach, reverse it there, and pull it back.

REPORT OF CASE

A 73-year-old woman awoke early on the morning of Sept. 26, 1954. Impelled by a desire to move about, she reached for a shawl. While putting this around her shoulders, she placed an open safety pin in her mouth prior to pinning the shawl in place. After a sudden sneeze at this juncture she swal-

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lowed the pin. She realized what had happened and immediately began to suffer substernal pain. She found it impossible, however, to convince the matron of the home that she had swallowed a pin, but by noon she was able to convince her that she had a pain in her chest. She was therefore taken to see her physician, Dr. Bernard P. Wolff. Dr. Wolff wisely realized the possibilities, and he began his examination by getting an x-ray of her chest. This showed the open safety pin in the lower third of the esophagus, and he immediately referred her to us.

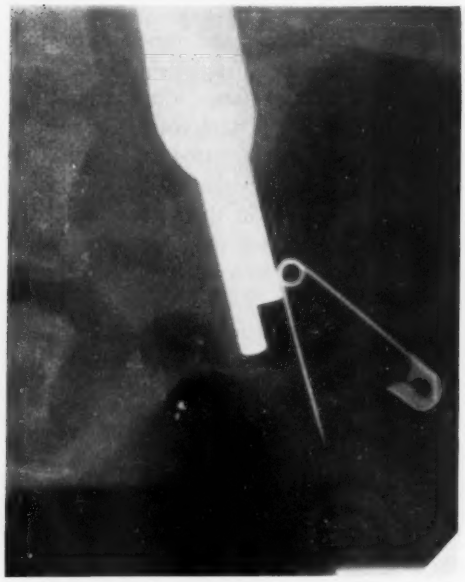

Fig. 2.—Two magnets are seen in contact with the ring of the open safety pin after its reversal in the stomach.

With the patient under ether anesthesia after the dentures had been removed, a magnet mounted as described above was passed into the esophagus under fluoroscopic guidance. Contact was promptly established between the magnet and the pin, and we began to introduce both of them into the stomach. Unexpected difficulty was encountered in passing the cardiac sphincter; such difficulty was indicative of achalasia or perhaps stricture. Finally both magnet and pin cleared the cardia, and we inflated the stomach by means of a hand bellows.

With the pin attached to the magnet, but hanging free in the inflated stomach, the pin was flipped so that the ring was attached to the end of the magnet and the point was away from it. It was expected that the magnet would thus bring the reversed pin back up the esophagus with the point trailing innocuously, but the patient had such a tight cardiac sphincter that it stripped the pin from the magnet. Even the insertion of a second magnet, properly oriented, was not enough to overcome the disparity between the strength of the achalasia and the strength of the magnet. Finally, the ring of the pin being just within the lower end of the esophagus, an esophagoscope was passed and the ring seized with forceps. Then it was quickly pulled back up the esophagus, and the woman was able to return to the home in a few days.

COMMENT

This patient was the oldest one from whom we have ever removed an open safety pin.

To insert shears into the esophagus and by this means to cut an open safety pin or to attempt to close one not only is difficult but is apt to cause considerable damage. To grasp the pin by the ring with forceps and push it down into the stomach is not difficult, but we have experienced considerable difficulty in reversing the pin in the inflated stomach.

This case presented surprising difficulties. Usually, once the pin is reversed, the original magnet will bring it promptly back up the esophagus and it is unnecessary to use an esophagoscope. We were disappointed that we did have to use an esophagoscope in this case and resort also to the use of a forceps. At the same time, we are convinced that the magnet facilitated this procedure a great deal.

The magnet is a product of the General Electric Company.

Ponce de Leon Infirmary.

POSTCRICOID CARCINOMA AS A SEQUEL TO RADIOTHERAPY FOR LARYNGEAL CARCINOMA

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DURING the past 20 years, scattered reports have appeared in the literature on the development of laryngeal, hypopharyngeal, and esophageal neoplasms occurring in patients previously treated with radiotherapy. For the most part, these have been late sequelae, occasionally as long as 32 years after completion of the initial course of radiation. All of these cases developed within the field of radiation following treatment for benign lesions, such as goiter or tuberculous adenitis.

Discussion of this problem must include mention of the rationale of radiotherapy as it was practiced prior to the popularization of the Coutard method. It was then believed that the radiation should be given quickly and in the highest feasible dosage in order to eliminate the disease as rapidly as possible. With refinement in radiation dosage, the use of higher voltage, and the institution of protracted therapy, the complications have decreased. The cases previously cited in the literature deal almost exclusively with complications of the outmoded form of radiation therapy. In the two instances here being reported, the malignant tumors appeared after protracted radiation with a 200 kv. machine.

Goolden,[1] in his review, cites Loosen (1936) as having reported a case which developed carcinoma of the larynx in 1935 after receiving radiotherapy for tuberculous cervical adenitis in 1919-1922. Goolden added four cases of his own to the six which he found in the literature. His four cases consisted of one fibrosarcoma, two carcinomas following treatment for thyrotoxicosis, and one carcinoma following treatment for tuberculous glands. Holinger and Rabbett[2] added three cases, two carcinomas and one fibrosarcoma, 27 to 32 years after radiation therapy for tuberculous cervical glands. Ombredanne and associates[3] presented a 33-year-old man who received about 50 radiation treatments for toxic goiter in 1938. In 1947 there were edematous changes in the right vocal cord which were attributed to the radiation. The entire larynx and hypopharynx were found to be involved by a fungating carcinoma in 1953. In the discussion, it was stated that Ombredanne had reported a case (1935) of carcinoma of the upper end of the esophagus following radiotherapy for goiter. It was also mentioned that van Nieuwenhuise presented three cases of laryngeal carcinoma following irradiation for goiter before the Société de Laryngologie des Hôpitaux de Paris, in January, 1952. In summation, we have been able to trace 18 cases reported either in the literature or as presentations before laryngological societies. All of these have been carcinomas of the larynx or esophagus which appeared many years after radiotherapy of the neck for benign toxic goiter or tuberculous adenitis.

Although radiation dermatitis and the subsequent malignant changes within the skin are a well-known clinical entity, proof that such neoplastic changes may occur in the deeper structures within the irradiated area has not been encountered fairly frequently and hence is difficult to obtain. Hatcher[4] reviewed 24 cases of delayed bone sarcoma, most of which occurred after radiation for tuberculous arthritis. He added three cases of bone sarcoma of his own, two of which followed radiation for benign giant-cell tumor

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From the Department of Otolaryngology and Laboratories of the Beth Israel Hospital.

of bone and one which occurred after radiation for breast carcinoma.

Many patients have developed multiple neoplasms over the years in either the same or remote sites. Countless thousands have received radiation therapy for benign and malignant lesions without ever developing sequelae in the form of malignant growth of the skin or the deeper structures.

Mucosal carcinoma is a rare complication of modern radiotherapy. The following two cases seem to suggest the development of carcinoma of the postcricoid region as a late sequela to radiotherapy for laryngeal carcinoma.

REPORT OF CASES

CASE 1.—H. Z., a 48-year-old white man, was first seen at the Beth Israel Hospital in January, 1931, because of hoarseness of two years' duration. A tumor mass was present involving the right vocal cord and extending into the anterior commissure. Biopsy from this region revealed a squamous-cell carcinoma with hornification (Fig. 1*A*). The patient received therapy from a 200 kv. machine set at 4 ma. The rays were filtered with 2 mm. Cu. The size of the field was 10 by 12 cm. TSD (target-skin distance) was 60 cm. The daily dosage was about 250 to 450 r of skin dosage from Feb. 10, 1931, to March 13, 1931, with a total dosage of 6500 r. After the radiation mucositis had subsided, the voice was good and the patient was asymptomatic. Examination after five years revealed no evidence of neoplasm. He was under observation in the follow-up clinic for many years without significant complaints.

On May 14, 1948, seventeen years after radiation for the carcinoma of the larynx, he was readmitted to the hospital because of dysphagia and weight loss of five months' duration. There was considerable atrophy of the skin of the neck, with marked telangiectasis. Mirror examination revealed no instrinsic lesion of the larynx. However, there was very slight abductor motion of the right cord and complete fixation of the left cord. The voice was hoarse and the pyriform fossa contained saliva. Esophageal x-ray demonstrated a constriction at C7-T1, with dilatation above the narrowing. Hypopharyngoscopy revealed an extensive ulceration of the right pyriform fossa extending into the mouth of the esophagus. Biopsy showed an anaplastic, immature, squamous-cell carcinoma (Fig. 1*B*). X-ray of the chest was normal, and no cervical adenopathy was palpable.

Fig. 1.—*A*, Mature epidermoid carcinoma of vocal cord (1931); reduced ¾ from mag. × 300. *B*, Immature epidermoid carcinoma of postcricoid region (1948); reduced ¾ from mag. × 200.

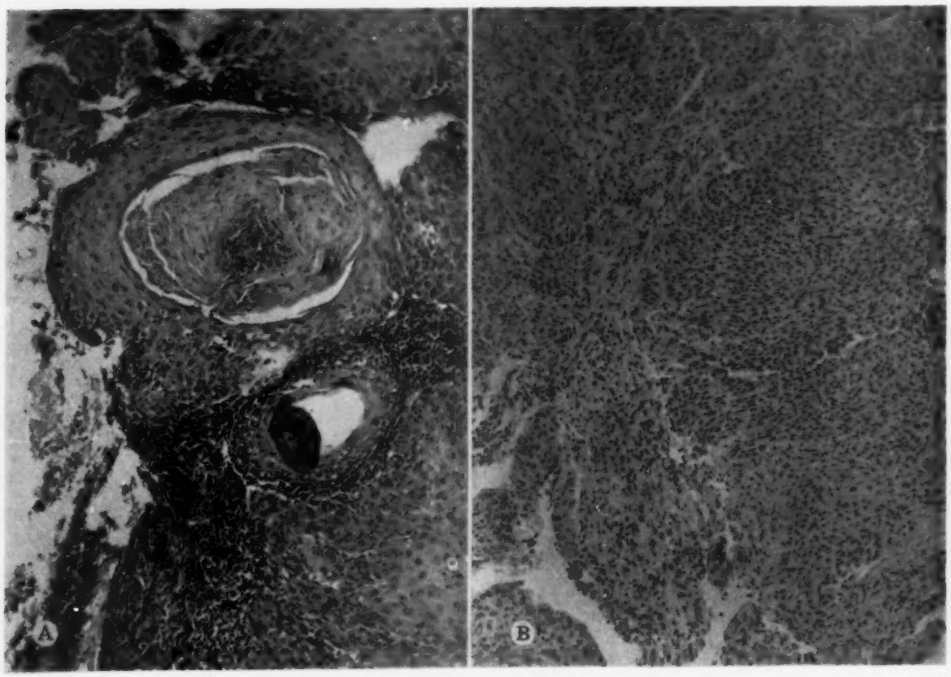

Fig. 2.—Surgical specimen showing ulcerative lesion of the postcricoid region. There was no involvement of the interior of the larynx.

A total laryngectomy, hypopharyngectomy, and cervical esophagectomy was performed by the Wookey technique, and a nasal feeding tube was inserted into the esophagus. The surgical specimen (Fig. 2) showed an extensive involvement of the postcricoid region, with encroachment upon the cervical esophagus. The interior of the larynx was entirely free of carcinoma. The patient developed some necrosis of the irradiated skin flap and a tracheoesophageal fistula proximally. His stay in the hospital was protracted due to the fact that the pharyngostome resisted several attempts at closure. A recurrence of carcinoma in the anterior esophageal wall developed, and the patient died 19 months after laryngectomy.

Case 2.—J. J., a white man, was first seen at the Beth Israel Hospital in May, 1931, because of hoarseness and some difficulty in swallowing of five weeks' duration. Mirror examination revealed a fungating mass occupying the right half of the epiglottis, right false cord, and right aryepiglottic fold. The right side of the neck contained two small, firm nodes. Biopsy of the mass was reported as mature, squamous-cell carcinoma (Fig. 3*A*). The patient received therapy from a 200 kv., 4 ma. machine, with 2 mm. of Cu filter. The size of the field was 14 by 9 cm. The TSD was 50 cm. The daily dose was approximately 450 skin r and was delivered during the period of June 4, 1937, to July 20, 1937, a total dose of 7128 r. He was examined at frequent intervals over a period of 14 years, during which time the larynx remained free of disease. In June, 1951, because of progres-

Fig. 3.—*A*, Mature epidermoid carcinoma of vocal cord (1937); reduced 3/4 from mag. × 250. *B*, Mature epidermoid carcinoma of the postcricoid region (1951); reduced 3/4 from mag. × 150.

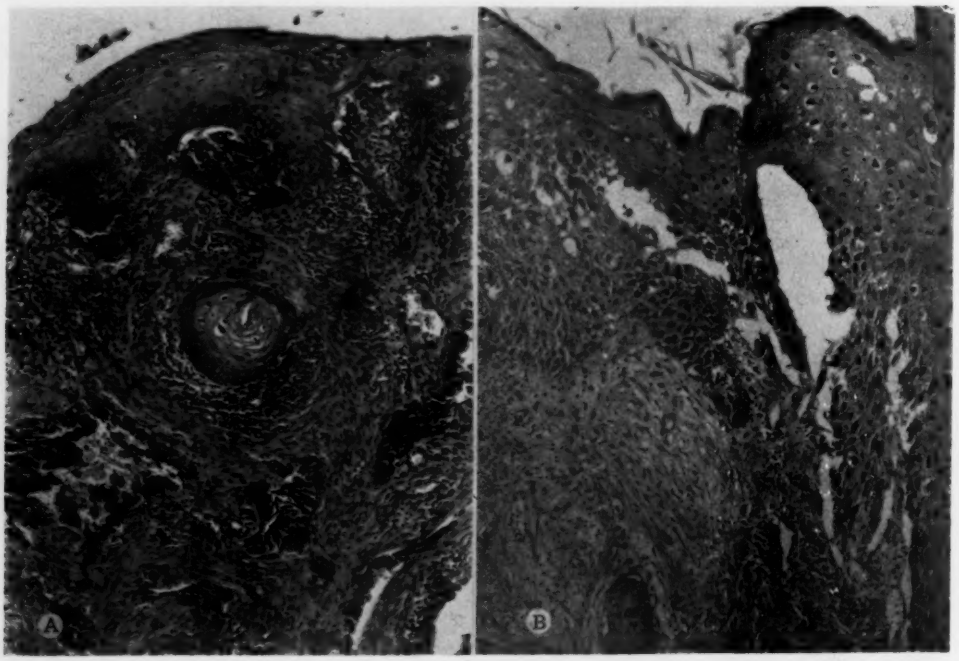

Fig. 4 (Case 2).—Esophagram showing constriction of upper esophagus at C7-T1.

sive dysphagia of many weeks' duration, an esophagram was performed. This showed constriction at C7-T1, with some proximal dilatation (Fig. 4). On admission to the Beth Israel Hospital, on July 2, 1951, there were noted atrophic skin changes, with marked areas of telangiectasis over the neck region. Hypopharyngoscopy showed a granulomatous ulcer at 16 cm. from the upper incisor teeth. The lesion involved the entire postcricoid region. Biopsy revealed an epidermoid carcinoma with areas of pachydermia (Fig. 3*B*). One week later, a total laryngectomy and cervical esophagectomy was performed. The surgical specimen (Fig. 5) showed an extensive, necrotic, postcricoid carcinoma. The interior of the larynx was free of neoplasm. Slough of the irradiated skin flap produced breakdown of suture lines and tracheoesophageal fistula. In September, 1951, repair of the tracheoesophageal fistula and Janeway gastrostomy was performed. There were multiple admissions during the ensuing 21 months for reconstructive procedures for closure of the pharyngostome by the Department of Plastic Surgery. When the pharynx had been fully reconstructed, metastatic lymph nodes were detected and excised. The patient died two years after surgery.

Fig. 5 (Case 2).—Surgical specimen showing extensive necrotic lesion in postcricoid region. The interior of the larynx was free from disease.

COMMENT

The occurrence of postcricoid carcinoma many years after protracted radiation poses the question of the cause-and-effect relationship of the radiotherapy. It is unlikely that the postcricoid lesion occurring locally 17 years after irradiation can be construed as a recurrence of the initial growth. Carcinoma in this location is indeed infrequent in males, so that it seems illogical to consider this as an independent, primary lesion, not related to the radiation therapy. The possibility must be entertained that the postcricoid carcinoma within the field of radiation is a late sequela of radiotherapy. We do know that mucosal malignant growths have occurred following radiation for thyroid and tuberculous disease. Accordingly, it can be postulated that similar mucosal lesions can occur after radiotherapy to the larynx.

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OSTEOMA OF THE FRONTAL SINUS WITH EYE DISPLACEMENT

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AN OSTEOMA of the frontal sinus was formerly considered a rare condition. Now there are an increasing number of cases being reported. There were 18 cases diagnosed from among 840,000 patients over a seven-year period at the Kasr-El-Ainy Hospital in Cairo, Egypt.[1] Two cases were seen among 48,000 patients at St. Joseph's Hospital, Ann Arbor, Mich., in 21 years. Teed collected 321 cases from the literature in 1941.[2] However, Dowling in 1945 reported 5 cases that were found among 7,000 patients over a two-year period.[3] Vadala and Somers in 1949 saw six cases in six months at the Fitzsimmons Army Hospital in Denver.[4] King reported seven cases in one year.[5] Newell reported four cases from Chicago in 1948.[6] Colver saw five cases in Los Angeles in 1948 and 1950.[7] The Mayo Clinic had 40 cases in a 20-year period ending in 1950.[8] Five cases were seen at Brooke Army Hospital in San Antonio, Tex., from among 19,076 patients in 1948.[9] Twelve additional cases were seen during the next two years, three of which required surgical treatment.

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Fig. 1.—Preoperative photograph of patient.

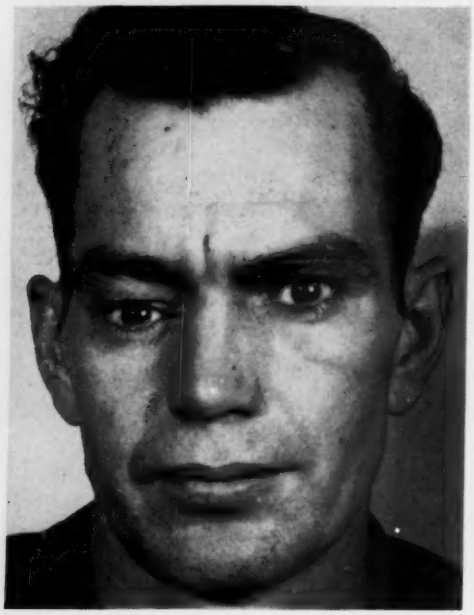


Fig. 2.—Preoperative roentgenogram showing an osteoma in the right frontal sinus and right orbit.

REPORT OF A CASE

A 28-year-old white man was admitted to the hospital with a slight hemoptysis. This had followed two weeks of upper respiratory infection. It was found to be secondary to a minimal bronchiectasis of one lobe of the lung. An osteoma of the frontal sinus was also found, and he was transferred to the Ear, Nose, and Throat Section.

Three years previously the patient had first noticed that his right eye was lower than the left eye. There were no other signs or symptoms. There was no history of any special trauma. Two years previously he had gone to a hospital for this condition and had roentgenograms taken for the first

time. He stated that no treatment was recommended.

Examination showed that the right eye and palpebral fissure was displaced downward 1 cm. and laterally 2 cm. (Fig. 1). There was chemosis of both lids of the right eye, most marked in the upper lid. The right palpebral fissure was narrowed. There was an irregular mass palpable in the upper medial portion of the right orbit. This mass was hard, but to some examiners it gave the impression that a little movement could be elicited. There was no diplopia. The vision was 20/25—2, Jaeger 1, on the right, normal on the left. An x-ray picture of the paranasal sinuses showed large frontal sinuses, with extension of the sinus into the orbital plate of the frontal bone (Fig. 2). There was a round mass in the right frontal sinus and another irregular mass in the superior nasal part of the right orbit.

The patient was given thiopental (Pentothal) sodium and nitrous oxide anesthesia. An incision was made through the right eyebrow, beginning ¼ in. from the outer edge, extending to the medial end and down the nose between the bridge of the nose and the inner canthus of the eye. The periosteum was reflected downward. It was absent under the superior orbital rim in the area immediately lateral to the midpoint of the brow. Here a mucocele about 1.5 cm. in diameter was exposed, lying in the orbit. The mucocele was attached to a bony mass, which, in turn, extended under the orbital rim into the frontal sinus. The periosteum over the frontal sinus was reflected upward. The right frontal sinus was exposed by removing the overlying bone with a gouge. This bone was 5 to 7 mm. thick. The sinus was small and almost completely filled by a firm, round, hard, bony mass 1 cm. in diameter. The mass extended under the orbital rim and connected with the mass in the orbit. The frontal bony mass was removed by gently prying it loose, rocking, and finally twisting it. It separated just under the orbital rim where the bone was moderately soft. There was no bony partition separating the frontal sinuses. The base of the osteoma was curetted as it entered the orbit near the nose. Some ethmoid cells were removed in this process as well as some moderately soft osteoma. The mucocele was removed. A nonabsorbable surgical (silk) suture was placed in the periosteum above the eye, and the eye was pulled downward and held by the suture. The orbital mass was now exposed, and a second mass could be seen to the nasal side of the original mass. The first portion was loosened by prying and rocking until it came free. Here, again, its connection with the other portion was with soft bone, apparently medullated bone. The third mass, which was adjacent to the nose and just above the lacrimal fossa, was now loosened and removed. The area adjacent to the nose contained softer bone. This was removed by curetting. Most of the bone of the orbit did not appear to be

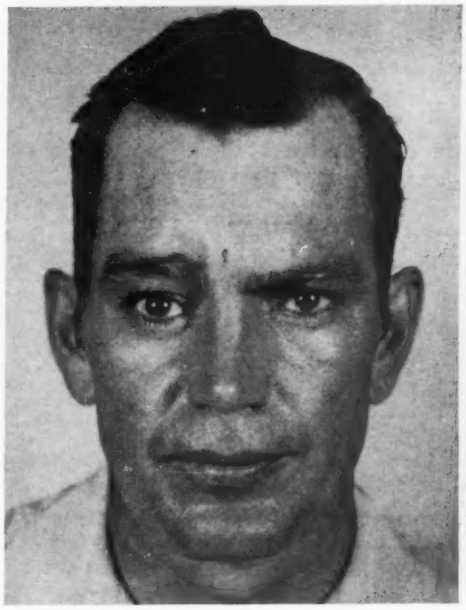
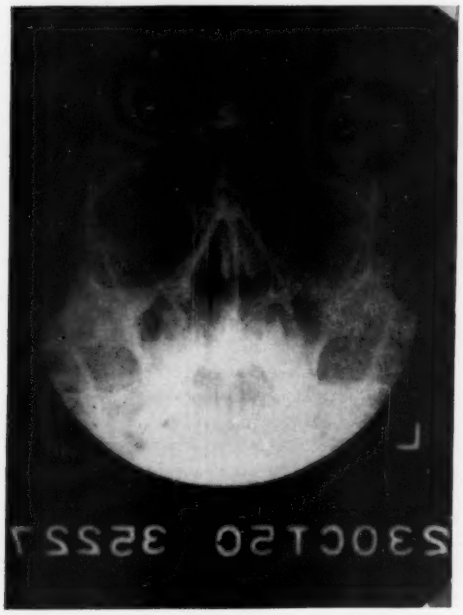


Fig. 4.—Photograph taken six months after surgery.

Fig. 3.—Roentgenogram after surgical removal of osteoma.



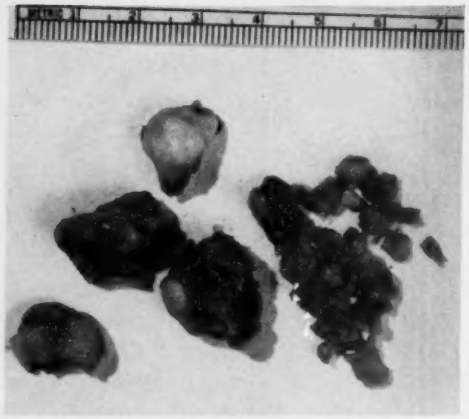


Fig. 5.—Osteoma after removal.

affected, being smooth and intact. However, there was no bony wall between the frontal sinus and the upper portion of the orbit, and in the naso-ethmoid region where the tumor had been removed by curetting it was difficult in some parts to determine the boundary between the osteoma and the ethmoid cells. All tissue that was thought to be osteoma was removed. A small bleeding vessel in the orbit at the base on the inner side was cauterized. A thin rubber drain was passed under the supraorbital ridge into the orbit, coming out through the frontal sinus at the medial end of the eyebrow. The wound was closed in layers with an absorbable surgical (gut) suture, and with a non-absorbable surgical suture for the skin. There was a moderate amount of serosanguineous drainage. The drain was removed on the fourth day. The roentgenogram showed a clearing of the frontal sinus and of the orbit (Fig. 3). The eye returned to its normal level after the operation (Fig. 4). Also, after operation the patient developed a diplopia. At the end of six months the diplopia would occur only when the patient was fatigued and lying down. After a year it was no longer present.

The excised tissue was sent to the laboratory, which reported: The specimen consists of 3 large and approximately 30 small fragments of tissue. The three large fragments measure approximately 1.5 by 1 by 1 cm. The small fragments all measure 4 to 5 mm. in their greatest diameter (Fig. 5). All of this tissue is bony in consistency, with a small amount of soft tissue attached. The bony fragments are irregular in size and shape. The surface shows areas of roughening. These bony fragments can be cut only with a saw. The cross section reveals a homogenous cortical-appearing bone. Three fragments of this specimen were placed in a button for decalcification. Microscopic examination: The specimen consists of fragments of dense compact bone and numerous dense bony trabeculations, some of which are connected and form interlacing pat-

Fig. 6.—Photomicrograph of the osteoma; reduced ⅕ from mag. × 10.

Fig. 7.—Photomicrograph of the osteoma; reduced ⅕ from mag. × 100.

terns. The dense bone shows a large pale area in which the nuclei are pyknotic and the bone is somewhat granular. The trabeculations are fairly compact but are separated by fibrous connective tissue containing numerous vascular spaces. A few small fragments of transitional epithelium are seen resting upon a thin basement membrane and a fibrous lamina propria * (Figs. 6 and 7).

COMMENT

A frontal sinus osteoma is usually diagnosed by examination of the roentgenogram. The symptom that brings the patient to his physician is often related to some other condition than the osteoma. A large number of cases have been reported in recent years; so the condition can no longer be considered rare. It is not often that a patient living near modern medical facilities will be allowed to have an osteoma progress so that it will cause the degree of deformity seen here. Removal is not difficult and is not hazardous.

SUMMARY

Clinical data are presented on a case of osteoma of the frontal sinus which involved the orbit, caused displacement of the eye, and had no diplopia until after surgery, at which time the diplopia was temporary.

Evidence is also submitted that frontal sinus osteoma is not rare.

Box O, Gorgas Hospital
Ancon, Canal Zone.

* Richmond, A. M., and Lind, C. J.: Personal communication to the author.

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News and Comment

GENERAL NEWS

The Dr. Charles Bramman Meding Award.—On the evening of Oct. 28, 1955, The Harlem Eye and Ear Hospital will bestow upon Dr. Franz Altman the Dr. Charles Bramman Meding Award.

This award is granted annually to the person judged to have made an important contribution for the advancement of otolaryngology and/or ophthalmology.

Dr. Altmann's film, "Embryology of the Ear," was considered an outstanding achievement. It will be shown at the Hospital auditorium coincident with the presentation of the award.

GLOMUS JUGULARIS TUMOR OF THE MIDDLE EAR

Report of an Early Case

RECTOR T. DAVOL, M.D., Greenwich, Conn.

GUILD first described a carotid-body-like structure which is found above the jugular bulb. This structure is associated with the tympanic branch of the glossopharyngeal nerve and the tympanic branch of the ascending pharyngeal artery. The function of this organ is not known, but presumably it functions similarly to the carotid body and is an organ sensitive to the degree of oxygen saturation of the arterial blood.

In 1945 Rosenwasser first described a tumor of this structure. Following his description there have been some 40 to 50 case reports of glomus jugularis tumors. Winship and associates reported 11 cases, 7 of which were benign and 4 malignant. Winship and Louzan reviewed the literature in 1951 and reported a case of their own. They reviewed 42 cases of glomus jugularis tumors in the literature and reported that the incidence of the disease is 80% in females, with a mortality rate of 34%. Whether benign or malignant, the tumor grows slowly but relentlessly, destroying the temporal bone by direct extension, eventually invading the nasopharynx and posterior cranial fossa.

Therapy is essentially surgical. Riemenschneider stated, "There is little evidence in the literature that x-ray therapy of tumors of either the carotid body or of the glomus jugularis accomplishes any considerable improvement." Therefore, the early recognition of these tumors before irreparable damage has been done is essential. The following case report is of interest from this point of view.

Submitted for publication May 10, 1955.

REPORT OF CASE

C. M., a 35-year-old Negro woman, was first seen on Sept. 9, 1954, with a complaint of buzzing in the left ear for six months. She also noted at the same time that she was losing some hearing in her left ear. She described the tinnitus as "whooshing" in character and stated that it had been progressively increasing in intensity. During the past four months she also complained of pain in the left occipital region. During the past three weeks she had had mild vertigo, associated with sudden changes in position. She had had no acute vertiginous attacks nor any bleeding from the ear nor weakness of the face.

The patient's past history revealed that she had always been well. She had a uterine fibroid removed and an appendectomy in 1950. She had had the usual childhood diseases and no previous history of ear trouble.

Physical examination revealed a well-nourished and well-developed Negro woman, who did not appear acutely or chronically ill. Examination of the left ear showed a normal ear canal. The tympanic membrane was intact, with a slight bulge in the posterior-inferior quadrant. The drum, however, was bright red, almost magenta in color. No pulsation could be determined. It had at first glance the appearance of an acute inflammation; however, the drum moved freely on alternate positive and negative pressure. The malleus was visible, and the light reflex was present. There was no acute pain and no temperature elevation. The Weber lateralized to the left, and the audiogram showed a 15.5% hearing loss in the left ear by air conduction. Roentgenograms of the mastoid revealed no roentgenographic evidence of bone destruction or significant difference in aeration of the temporal sinuses. Complete blood cell count and urinalysis showed no abnormality, and VDRL tests were negative.

The presumptive diagnosis of glomus jugularis tumor was made, and on Sept. 17, 1954, surgery was performed. An attempt was made to remove the tumor by elevating the drum from its sulcus, but the tumor was seen to extend into the mastoid antrum and could not be completely exposed. Because of the severe bleeding which occurs when these tumors are damaged no attempt to remove the tumor by this approach was made. A radical mastoidectomy was then performed and the tumor completely exposed. The tumor was found to extend

up just into the mastoid antrum. The tumor was then lifted out with a ring curette. It measured 1 cm. in diameter and was spongy in consistency. It was removed in its entirety, and the radical cavity was then completed. There was no undue bleeding. The bony canal of the facial nerve was found to be eroded under the tumor for about one-third of its length, but the nerve was intact. Pathological report: The specimen was a mass of gray and red tissue of irregular shape which measured 0.3 by 0.5 by 1 cm. On microscopic examination the mass was covered by a layer of stratified columnar epithelium, which was consistent with

Glomus jugularis tumor removed from middle ear.

the lining epithelium of the sinuses. The tumor was composed of masses of epithelioid cells, with innumerable large and small blood vessels passing through the masses. In some areas the cells appeared to consist almost entirely of vesicular nuclei. However, where they were more widely separated, it was possible to see a rather abundant, slightly eosinophilic cytoplasm. The tumor had the typical structure of the glomus tumor from the jugular vein. This mass appeared histologically benign, and the sections suggested that the entire tumor had been removed. The pathological diagnosis was tumor from mastoid sinus, glomus jugularis.

Postoperative course was uneventful. The tinnitus ceased and the occipital headaches were no longer present. The radical mastoid cavity healed well. To date there have been no signs of recurrence.

COMMENT

A case of a glomus jugularis tumor which was diagnosed early is reported. Although this tumor was small, it had already encroached on the facial nerve in the middle ear. Early operative removal of these tumors is a relatively simple procedure and should be done before there are evidences of encroachment on vital structures in the temporal bone. The diagnosis can be readily suspected from the otoscopic picture and history. Biopsy should not be done when the tumor is found in the early stages, as it complicates the removal of the tumor by causing profuse bleeding.

SUMMARY

A brief review of the literature on glomus jugularis is made.

A case is reported in which the diagnosis was made before damage to vital structures in the temporal bone had occurred.

30 Millbank Ave.

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DARIER'S DISEASE OF THE LARYNX

EDWIN R. FISHER, M.D.
and
STEPHEN L. KYLER, M.D., Pittsburgh

DARIER'S disease is a rare but well-recognized dermatologic disorder of unknown etiology characterized by papular, vesicular, and occasionally ulcerating lesions of the skin, particularly of the face, extremities, and inguinal region. Although it most frequently occurs in childhood, examples in infancy [1] as well as adulthood [2] have been recorded. The clinical course is slow but progressive, with apparently little effect upon general health except when secondary infection supervenes. Spontaneous remissions have been observed.

Examples of Darier's disease with involvement of the tongue, pharynx, esophagus, vulva, and oral mucosa have been described.* Although Lever [6] cites Brünauer's [5] reference to laryngeal lesions, we have been unable to find such a notation in his original publication.

The case to be presented represents, to our knowledge, the first recorded instance of Darier's disease of the larynx. In addition, it reemphasizes the value of biopsy with histologic examination of laryngeal lesions of unusual appearance.

REPORT OF A CASE

History and Physical Examination

A 39-year-old white mail clerk had experienced intermittent episodes of hoarseness for 10 years prior to admission to the hospital. These were accompanied by soreness of the throat, moderate dysphagia, and occasionally blood-streaked sputum. Although spontaneous relief of these symptoms occurred, he never was completely free from hoarseness. On one previous occasion a biopsy of the vocal cords was performed and the diagnosis of hyperkeratosis rendered. The patient stated that he never experienced any dermatitis which might be considered as suggestive of cutaneous Darier's disease. The past medical and other occupational histories were noncontributory.

Examination revealed the patient to be well nourished and not appearing acutely or chronically ill. The pharynx and hypopharynx were normal. Mirror laryngoscopy revealed both vocal cords to be thickened and to contain small hyperkeratotic nodules on their surfaces. Similar lesions were present on the free edge of the epiglottis and mucosa of the interarytenoid space. The intervening mucosa was congested. There was no impairment of the motion of the vocal cords. Bronchoscopic examination revealed normal mucous membrane. There was no palpable cervical lymphadenopathy.

Laboratory studies, including hemogram and urinalyses, were within normal limits. Serologic tests for syphilis were negative. Skin tests with tuberculin, histoplasmin, and coccidioidin were also negative, as was x-ray examination of the chest.

A biopsy was performed with removal of several lesions from both vocal cords and the epiglottis.

Pathologic Examination

The sections from the various sites revealed polypoid fragments of laryngeal mucosa. The mucosal epithelium revealed acantholysis and suprabasal cleavage with the formation of intraepithelial lacunae or slits and in some areas vesicles and bullae (Figs. 1 and 2). Dyskeratotic epithelial cells lined the lacunae and bullae in many areas. Careful search revealed corps ronds (swollen squamous cells with dense eosinophilic cytoplasm and optically clear halos about hyperchromatic nuclei) (Fig. 3) and grains (shrunken squamous cells with hyperchromatic ovoid nuclei and scanty but dense eosinophilic cytoplasm) (Fig. 4). These latter were also present in the upper layers of the mucosal epithelium, which likewise was moderately hyperkeratotic. Although a rare mitosis was observed, atypical forms or other evidence of carcinomatous change was lacking. The lacunae contained a few red blood cells, lymphocytes, and neutrophiles, as well as desquamated dyskeratotic epithelial cells. The subepithelial stroma projected into lacunar spaces,

Submitted for publication July 25, 1955.

From the Departments of Pathology and Otolaryngology of the University of Pittsburgh and the Veterans Administration Hospital.

* References 3 to 5.

Fig. 1.—Section revealing formation of lacunae in mucosal epithelium. Suprabasal cleavage and acantholysis are apparent. Reduced ⅕ from mag. × 150.

forming vegetations or papillae which frequently contained vascular cores. A moderate lymphocytic, plasma-cell, and neutrophile infiltrate of this subepithelial stroma was also encountered. Eosinophiles were not evident. Inclusion bodies were not apparent, and a periodic acid-Schiff stain for fungi was negative.

Diagnosis: Darier's disease of vocal cords and epiglottis.

Treatment

The patient was given 200,000 units of vitamin A and 150 mg. of cortisone daily for 20 days. His voice dramatically improved after one week of such therapy, returning to what he considered as normal for the first time in 10 years. Reexamination of the larynx failed to disclose lesions, although the vocal cords were slightly thickened. The patient was last seen three months after the last examination. At this time he had experienced no recurrence of symptoms or laryngeal lesions.

COMMENT

Although clinically the laryngeal lesions observed by mirror laryngoscopy were suggestive of diffuse hyperkeratosis or fungus infection, histologic examination allowed for their positive identification. The morphologic

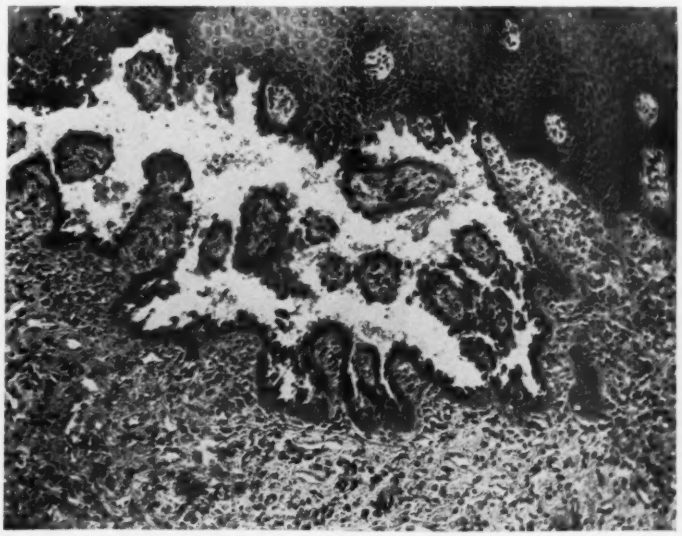

Fig. 2.—Section revealing intraepithelial bulla, with vegetations being formed by underlying stroma; reduced ⅕ from mag. × 150.

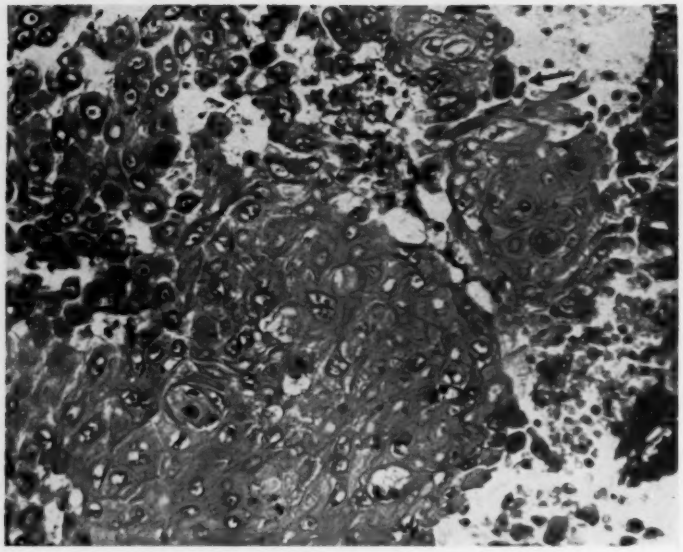

Fig. 3. — Dyskeratotic epithelium revealing corps rond (arrow); reduced ⅙ from mag. × 300.

features of suprabasal cleavage with the formation of lacunae, vegetations, and dyskeratotic cells characterized by corps ronds and grains are identical to those of the cutaneous form of Darier's disease.† The presence of bullae within the mucosal epithelium is like that noted in familial benign chronic pemphigus described by Hailey and Hailey.[8] However, the other morphologic features of this latter are identical to those of Darier's disease, and many ‡ believe the former to represent a bullous variant of this disorder rather than a disease suis generis. The presence of both lacunae and bullae in the laryngeal lesions encountered in this case illustrates this close relationship. The lesions of Darier's disease differ from those of pemphigus vegetans by the lack of dyskeratosis

† References 6 and 7.

‡ References 9 to 11.

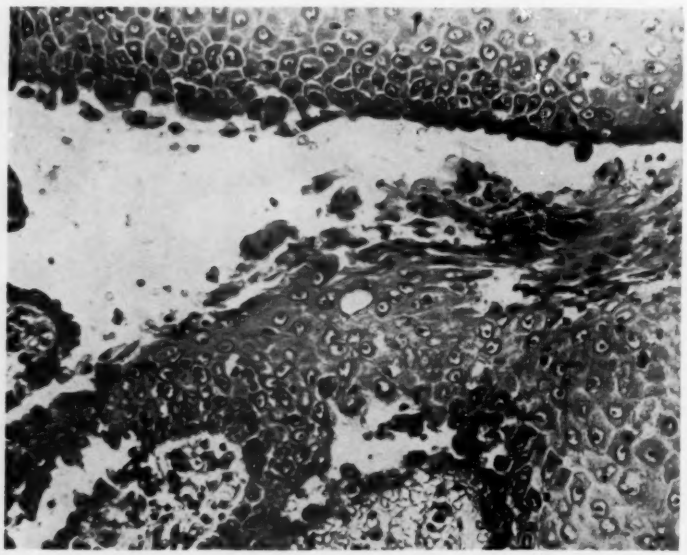

Fig. 4.—So-called grains are evident within an intraepithelial lacuna; reduced ⅙ from mag. × 300.

and the presence of an abundant inflammatory infiltrate containing many eosinophiles in the latter. Although dyskeratosis and rare mitoses were present in these lesions, the absolute criteria of carcinomatous change were lacking. It is interesting to note that there have been no acceptable cases of carcinoma arising in Darier's disease of the skin.[12]

The clinical course exhibited by this patient with Darier's disease of the larynx is not unlike that noted in patients with cutaneous involvement. The administration of massive doses of vitamin A was based upon the observations of Peck and associates,[13] who observed a favorable response to this vitamin in several patients with cutaneous Darier's disease. Because of this, they postulated that this disease might represent a deficiency state. Evidence of such a vitamin deficiency was clinically not apparent in the patient reported herein. Since the patient also received cortisone, the exact therapeutic efficacy of vitamin A in this case cannot be evaluated. The possibility that the recrudescence observed was spontaneous appears unlikely, since the return of a completely normal voice and disappearance of the lesions had not been observed on previous occasions. The asymptomatic period following discharge from the hospital is also unlike the natural course of this patient's illness prior to this therapy.

SUMMARY

A case of Darier's disease of the vocal cords, epiglottis, and interarytenoid space of apparently 10 years' duration in a 39-year-old man is presented. To our knowledge, this is the first recorded example of this disease in the larynx. The lesions of the larynx regressed and the patient experienced normal voice for the first time since the onset of his illness after the administration of vitamin A and cortisone.

The value of biopsy and histologic examination of laryngeal lesions of unusual appearance is apparent.

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Clinical Notes, New Instruments and Techniques

CARTILAGE PERFORATOR

IRVING B. GOLDMAN, M.D., New York

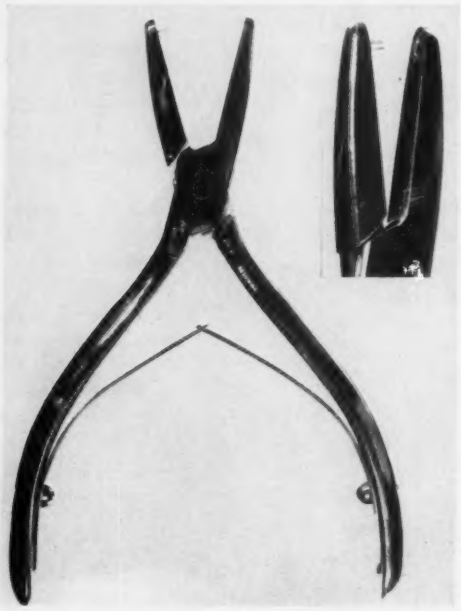
The cartilage perforator was devised to make holes through cartilage implants. It consists of a punch in which the upper jaw is fenestrated and the lower one contains a riveted pin which penetrates the cartilage. The shanks have a spring action which readily opens and closes the instrument.

The cartilage is not fractured when the holes are produced. The punctures permit better anchorage in the recipient area. They also allow fibroblasts to penetrate the holes for eventual fixation. The perforator is especially useful for bovine and septal cartilage implants.

Submitted for publication May 16, 1955.

Cartilage perforator manufactured by Storz Instrument Co., St. Louis.

From the Division of Rhinoplasty, Otolaryngological Service, Mount Sinai Hospital.



Cartilage perforator

NEW SELF-RETAINING RETRACTOR FOR ENDAURAL SURGERY

JOHN M. REHBERGER, M.D., Baltimore

Improved exposure of the operative site is always desired by the surgeon. Dissatisfied with the various retractors in use for endaural surgery, I perfected an instrument which has proved very adaptable during the past four years in mastoid and fenestration surgery.

The retractor is of stainless steel and is so designed that it may easily be altered during the operation to suit the requirements of the operator at that moment. The main retractor has two curved arms which are opened to the desired exposure by means of a thumb screw. Posterior retraction of the periosteum and soft tissues covering the mastoid portion of the temporal bone and anterior retraction of the periosteum and soft tissue covering the squamous temporalis and temporal muscle above the tragus are produced by turning the thumb screw at the base of the retractor.

Attached to the ends of the main retractor arms are two curved arms, which may be added when needed and when opened create a parabolic curve, giving excellent exposure and permitting full use of the drill.

Two detachable retractors may be used as needed—one for retraction of the temporal muscle and exposure of the dural plate, the other for exposure of the mastoid tip—by adjusting the perforated portion to small knobs located at the base of the retractor and at the junction of the two detachable arms.

Counter traction is maintained by the soft tissue and muscle.

The retractor is machined for maximum strength within minimum weight and may be adapted to other types of surgery.

3501 St. Paul St. (18).

Submitted for publication July 12, 1955.

Retractor manufactured by George P. Pilling & Son, Philadelphia.

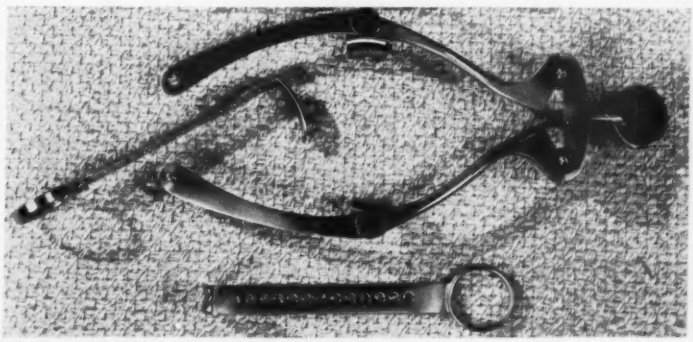


Fig. 1.—Retractor open to show parts.

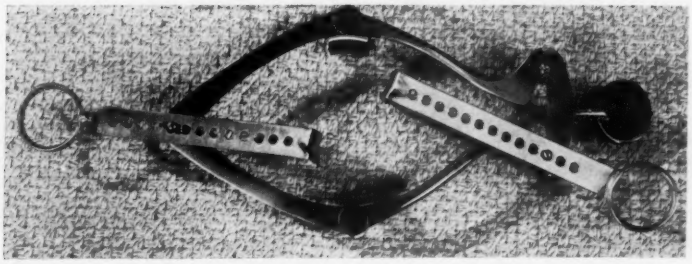


Fig. 2.—Surgical position of retractor.

Progress in Otolaryngology

OTITIS MEDIA AND COMPLICATIONS

Summaries of the Bibliographic Material Available in the Field of Otolaryngology for 1954

B. R. DYSART, M.D., Pasadena, Calif.

THE LITERATURE of 1954 on otitis media and complications contains many papers that are very interesting and instructive. The growing awareness of the importance of the conservation of hearing is especially reflected in the large number of articles on the modified radical mastoidectomy.

ANATOMY

Diamant [1] (Halmstad, Sweden) examined and classified the degree of pneumatization of the mastoids of 356 patients. He used a planimeter to measure the number of square centimeters covered by the cells on the x-ray films. He classified his material in five groups according to the method of Schwarz. In his classification, Group 1 has extremely large development and Group 5 has no development. His resulting groups were very similar to the remarkably large group of 3048 published by Seppala in 1946. About 4% had extremely large development. The second group, 35%, had moderately large development, with cells extending into the zygomatic region and into the squama temporalis. Group 3 comprised 28% and had average development. Group 4, comprising 19%, had cells only in the antral region. Group 5, 13% of the total, had no air cells.

BACTERIOLOGY

Ronning and Gardborg [2] (Oslo, Norway) studied the resistance to antibiotics in 997 cases of otitis media during 1951 and 1952. There were 2372 cultures and sensitization tests performed. In 1951, 67% of the bacteria were sensitive to penicillin and in 1952, 67.3%. Mastoidectomy was done in 19.5% of the resistant cases and in 6.8% of the penicillin-sensitive cases. They found the Hemophilus influenzae organism to be of increasing importance as a cause of mastoiditis, partly because it is very often penicillin-resistant, 70%. About 67% of the Staphylococcus aureus strains were penicillin-resistant. They regarded the Staphylococcus as a secondary invader in most cases but sometimes very dangerous because of its resistance to all antibiotics.

They stated that their high percentage of mastoid operations was due to the fact that many cases came in late and had had small doses of antibiotics.

ANTIBIOTICS

Farber, Ross, and Stephens [3] (Oakland, Calif.) sent out a questionnaire to central California physicians inquiring about sudden severe reactions to penicillin. Over 100 replies were received listing more than 300 severe anaphylactic reactions to penicillin. Seven fatal reactions were reported. There were 520 moderate reactions. Ten severe reactions were reported to streptomycin and 49 moderate reactions.

After seeing in their own practice seven severe reactions in "more than 1000" injections, they began to combine an antihistamimic with each injection and have had no sudden severe reaction in more than 3000 injections. They have used aqueous diphenhydramine (Benadryl), 10 to 20 mg.; tripelennamine (Pyribenzamine) solution, 10 to 20 mg.; methapyrilene (Histadyl), 20 to 40 mg., or chlorpheniramine (Chlor-Trimeton), 4 mg. Each of these solutions has seemed equally effective.

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In treatment of two sudden reactions they gave epinephrine, 1 : 1000, intramuscularly and diphenhydramine intravenously. They advised that these two drugs be immediately available whenever penicillin is being injected. They also advise oxygen under positive pressure to combat pulmonary edema. They also advise avoiding penicillin for allergic patients. [Reports of severe anaphylactic reactions to penicillin are becoming commoner. Penicillin O has been reported as safe in cases that have unfavorable reactions to penicillin G, but it is not entirely safe, as several near-fatal reactions have been reported. Before any administration of the antibiotics the patient should be carefully questioned about previous reactions. As Dr. Isaac Jones has said, "The patient demanding penicillin may be mollified if we say, 'We don't shoot sparrows with a cannon.' "]

Spink [4] (Professor of Medicine, University of Minnesota) spoke at the American Academy of Ophthalmology and Otolaryngology symposium on antibiotics and summarized his experience as follows:

> Penicillin is a remarkable antibiotic. After more than 10 years of clinical trial, it is still the drug of choice for many infectious diseases. During this time only one species of bacteria has posed a serious problem because of the appearance of penicillin-resistant strains, and that is the staphylococcus.

Not more than 2% of the patients developed reactions. He advised combinations of different antibiotics in severely ill patients. For pneumococcal or meningococcal meningitis he advised penicillin in sulfadiazine. He has never seen any unfavorable results from penicillin given intrathecally in daily doses up to 20,000 units. For severe staphylococcal disease he advised penicillin and bacitracin or erythromycin.

Halbert [5] (New York), continuing the Academy symposium, spoke on bacterial resistance to antibiotics. He quoted many reports of the increasing resistance of many bacteria, especially the S. aureus, to most of our antibiotics. It seems that this increased resistance is a fairly permanent attribute of micro-organisms. Several reports are advising the use of combinations of different antibiotics to prevent or delay the emergence of resistant strains of organisms.

Maxwell [6] (Ann Arbor, Mich.) in the same symposium advised against the use of antibiotics in mild infections because of the danger of reactions and because of the increasing resistance that many organisms are developing. He regarded penicillin as the most generally useful antibiotic for respiratory infections but advised sensitivity tests in serious cases. Once begun, the antibiotic should be given in full dosage for at least five days and then until two days after all signs of acute infection have subsided. The sulfa compounds should not be entirely replaced by the antibiotics.

Rudberg [7] (Stockholm, Sweden) compared the effectiveness of penicillin given by mouth with that in a group treated by penicillin injections. He treated three other groups at the same time: one, the control group, with no antimicrobial, one with sulfonamide tablets (containing sulfathiazole, sulfapyrimidine, and sulfamonomethylpyrimidine), and a group with combined penicillin tablets and sulfonamide tablets. Altogether about 1500 cases were observed, and much time was taken in analyzing the results. There are 27 tables charting different aspects of the investigation, which was published in a supplement of *Acta oto-laryngologica*.

He agreed with others that infections caused by H. influenzae did not respond well to penicillin. About 15% of his cases cultured H. influenzae.

He concluded:

> The oral administration of penicillin is as effective as the parenteral administration . . . in the treatment of acute, uncomplicated otitis media. When penicillin tablets and sulfonamide tablets are given in combination, the therapeutic results are as good as with either . . . but are no better. It is therefore superfluous to give a sulfonamide in addition to penicillin. Sulfonamide alone gives considerably poorer therapeutic results than do other methods. . . .

[An excellent paper. Since penicillin given by mouth is apparently as effective and since

it avoids the sudden anaphylactic reactions, it should be used oftener. However, larger doses are advised.]

Lüscher and Gentinetta [8] (Basel, Switzerland) compared three groups of patients with severe acute otitis media and complications. The first group, of 602 patients, was seen between 1937 and 1940, before sulfonamides were available. The second group, of 505 patients, was admitted to the same clinic of the University of Basel during the years 1941 to 1944, when sulfonamides were used. The third group, of 189 patients, was seen from 1949 to 1952, when penicillin was used. Operation was done in 38.5% of the first group, 26.3% of the second group, and 24.9% of the third group. Intracranial complications occurred in 10.5% of the first group, 4.2% of the second group, and 5.7% of the third group. Death occurred in 2.8% of the first group, 0.8% of the second, and no deaths occurred in the third group.

In the group of 189 treated from 1949 to 1952 there were 47 patients who required mastoidectomy, 29 of whom had had neither penicillin nor sulfonamides. Sixteen cases had been given penicillin or sulfonamides inadequately or too late. Only two patients were resistant to penicillin. The authors concluded that treatment with penicillin or other antibiotics should be started as soon as possible in every case of severe otitis media. They advised a daily dose of 1,000,000 units for adults and correspondingly smaller doses for children. The course should be longer than two or three days. Other antibiotics are indicated where penicillin has failed.

Tamari and Szanto [9] (Chicago) described microscopic findings in mastoids infected by the Pneumococcus Type 3 and found them similar to findings in mastoids which had been treated by antibiotics. In "masked" otitis and mastoiditis there was found an exudate composed of fibroblasts, histiocytes, plasma cells, and collagen. In contrast there was an accumulation of polymorphonuclear leucocytes in the untreated cases of mastoiditis.

LOCAL USE OF ANTIBIOTICS

Hearn [10] (Greenville, S. C.) reported the use of chloramphenicol (Chloromycetin) and boric acid powder (4 parts of boric acid to 1 part chloramphenicol) in treating 95 infected ears. There were 53 cases of external otitis, 12 cases of chronic otitis media, and 4 cases of infected modified radical cavities. Only 3 of the 95 ears failed to show improvement. Three were improved but did not return after two treatments, and the other 89 became dry. There were no sensitivities noted. The powder had no tendency to cake, but caking was noted when using oxytetracycline (Terramycin) and chlortetracycline (Aureomycin).

Ausband and Harrill [11] (North Carolina) reported results of the local use of chloramphenicol in 38 cases of draining ears. Dry ears were obtained in 53%, improvement in 27%, with no improvement in 10%. A solution of chloramphenicol, 0.5%, ethyl aminobenzoate (Benzocaine), 1%, and propylene glycol was used, the patient being instructed to use 3 drops in the ear four times daily. Twenty-three cases were external otitis, seven were otitis media, and three were chronic infections following radical mastoidectomy. Ten per cent of the group developed allergic irritation. [The inclusion of ethyl aminobenzoate in the solution probably caused some of the allergic reactions, and is not necessary. More articles are reporting the use of powders than solutions, and their results seem to be better.]

Pitman [12] (New York) reported 96 cases of chronic suppurative otitis media treated through the Eustachian tube by means of the Pitman catheterizing Eustachioscope. A No. 4 uretal catheter was introduced into the Eustachian tube and 1.5 cc. of freshly prepared 30% sulfathiazole sodium solution with penicillin was introduced into the middle ear. If after three treatments there was no improvement he would substitute another antibiotic for the penicillin. Cases of cholesteatoma were not treated. Seventy per cent of the treated ears became dry. [It seems that

the medications could be introduced more easily and effectively through the ear canal.]

Das, Singh, Taneja, Khanna, and Chaddah [12] (Punjab, India) reported cultures and sensitization tests done on 150 cases of chronic otitis media. The organism Proteus vulgaris was found in 83 ears, Bacillus pyocyaneus in 26, Staphylococcus aureus in 22, Staphylococcus albus in 14, viridans type of Streptococcus in 3, and hemolytic streptococci in 2.

Dihydrostreptomycin was the only drug which inhibited growth of all organisms. Infections were treated by ear drops of 5% dihydrostreptomycin in infections caused by P. vulgaris and B. pyocyaneus. Oxytetracycline, 0.5%, was used for Staphylococcus pyogenes and the viridans type of Streptococcus, and chloramphenicol, 0.5%, was used where the coli-aerogenes group was found. When the ears became dry, they were treated with a powder containing equal parts of dihydrostreptomycin, oxytetracycline, and sulfadiazine. [This interesting paper showed careful preparation.]

ACUTE OTITIS MEDIA

Harrison [14] (Tennessee) began practice with the idea that "drum-lancing" was obsolete and for two years did not open a drum. Then after reading about conduction deafness as a result of incompletely resolved purulent otitis media with serous effusion, he began to open the drums that failed to clear up quickly on antibiotics. He found that they cleared much more quickly, with fewer cases of impaired hearing.

CHOLESTEATOMA

Simpson [15] (England), in his president's address before the Otology Section of the Royal Society of Medicine, spoke on the origin of cholesteatoma. He found cholesteatoma in 90% of 250 operations for chronic otitis media. At one time chronic otitis media used to be considered a reproach to otology. He now thinks that cholesteatoma is not only preventable but that when it does occur "operation is inevitable." He believes that an effusion into the attic of serum high in cholesterol may initiate the process. In the series of 250 mastoidectomies for chronic otitis he found six cases of "black" cholesteatoma, probably caused by hemorrhagic exudate into the middle ear and mastoid. He describes one case in detail in which the very cellular mastoid was filled with black cholesteatomatous material and the middle ear was filled with black tarry material. The attic was completely eroded. Microscopic examination showed cholesterol crystals in granulation tissue. The black pigment stained positively for iron.

He reasoned that mucosal hemorrhages frequently occur in infections due to the H. influenzae. It is well known that separation of cholesterol crystals may occur in an enclosed hemorrhage. In a patient with high-serum cholesterol there could be deposits of crystals in any small serous effusion. Blood-serum cholesterol was measured in 81 cases of his series of chronic otitis, and in 45 cases the cholesterol was found to be unusually high, over 300 mg. per 100 ml., and cholesteatoma was found in every case. He quoted Dan McKenzie:

> Cholesteatoma may be found without any membrane whatever. The lining [may] be devoid of epidermal cells . . . and betray no evidence of any inflammatory reaction . . . a closed cholesteatoma [is] devoid of fœtor.

The author reasoned that if McKenzie's theory is correct it would explain the success of those who leave the lining of the cholesteatomatous cavity. If the lining is a protective response the removal of the cholesterol should allow the epidermal cells to revert to function and become true epidermis. [A very interesting paper.]

MASTOIDITIS

Baron [16] (San Francisco) has described in detail his technique in performing the modified radical mastoid operation, giving special attention to the preservation of hearing. He advises that before any bone work is done the membranous canal be carefully separated from the bony canal in all cases. The final technique is not determinable until the area

of pathology is exposed. This allows the membranous canal skin to be used to the best possible advantage. There are nine illustrations which show his ideas very well. Most chronically discharging ears that require surgery have cholesteatomas, and a high percentage have attic perforations or posterosuperior marginal perforations. Many of these cases have good hearing, and if the cholesteatoma matrix sealing off the middle-ear cavity is preserved, the hearing is more likely to be unchanged. Any extension of the matrix into the region of the labyrinth or mastoid should be carefully removed.

When the pathology has been dealt with, the entire membranous canal wall is cut through the long axis down to and through the perforation, thereby eliminating the perforation. This forms a flap, to be reflected over the facial ridge. If the hearing is below the 40 db. level the matrix may be lifted to inspect the ossicles and remove granulations.

He concludes that the technique of preserving the matrix is most valuable in conserving hearing.

Palva and Siirala [17] (Finland) measured very carefully the hearing in 141 patients before and after operations for chronic otitis media. Both pure-tone and speech audiometry were done and are presented in charts. They advised that in all cases in which the hearing loss is less than 20 db. the modified radical operation be done and the ossicles preserved. In cases where the preoperative loss is between 20 and 40 db. the incus and head of the malleus can be removed without limiting the chances for reasonable hearing. Where the preoperative hearing loss was more than 40 db. there was usually perceptive loss and complete removal of the ossicles and drum was done if at all indicated. In cases with good hearing they did not hesitate to leave the cholesteatoma matrix and had found no recurrence as a result. In their radical cases they removed the matrix completely and used half-thickness skin grafts. There was no significant hearing loss after the complete radical operation.

Thorborn [18] (Blackpool, England) presented his results on 188 cases of mastoidectomy operations done for chronic otitis media. There were 94 modified radical operations and 94 complete radicals. He urges early modified radical procedures to conserve hearing and has "been influenced by the shock experienced on opening up mastoids in some children with only a short history of ear trouble." He then gives in detail the case of a child of 5 years who was found to have cholesteatoma in one ear with a history of drainage of only two weeks' duration. One year later a tiny crust was seen over the attic in the other ear. With increasing deafness as the chief indication he opened the mastoid and found cholesteatoma in an expanded antrum and attic. Hearing remained excellent, and both ears remained dry after modified radical operation.

Dingley and Zwiefach [19] (London) reported their results in 38 operative cases of chronic attic disease. They urge modified radical operations, performed early to conserve loss of hearing. They obtained dry cavities in 36 of their cases. In the 23 cases that had careful hearing examinations before and after operations 56% had some improvement in hearing, 30% had no change, and 14% had some loss. The incus was removed in most cases; "if preserved it will either fall out or become buried in a mass of tissue filling and obstructing the aditus." They tried to decide before operation which cases had cholesteatoma and which had granulations only. They found that in 23 cases with an especially bad odor 21 had cholesteatoma. The cases with granulations and no cholesteatoma frequently responded to treatment without operation.

Juers [20] (Louisville) wrote an interesting article on the preservation of hearing in surgery for chronic ear disease. His prerequisites for good hearing after surgery are the following:

(*a*) An air-containing inflatable space over the round window

(*b*) An intact pars tensa

(*c*) No fistula from the tympanic cavity into the attic

(*d*) An intact or unimpeded ossicular chain or, if the incus is removed, contact between the pars tensa and the stapes should be assured. If such contact exists before surgery, this should not be disturbed. If such contact is not present, it should be established by the surgical procedure of myringostapediopexy.

Excellent diagrams are given showing the probable method of formation of cholesteatoma in the mastoid attic without perforation. Diagrams of his method of performing myringostapediopexy are given.

Brunner [21] (Newark, N. J.) reported his observations on the autopsy examination of 12 temporal bones of patients who had had radical mastoid operations previously. He reminds us that as early as 1893 there was a controversy between Zaufal and Siebenmann over whether to remove the matrix of cholesteatoma completely or not. Siebenmann advocated removal of only the necrotic masses of cholesteatoma and did not disturb the matrix. Zaufal removed the matrix by curettage, electrocautery, and cauterization with trichloroacetic acid. Brunner thinks that complete removal is neither necessary nor feasible. His microscopic sections show that there is a spontaneous expulsion of the entire matrix, or parts of it, subsequent to the radical operation. He thinks that if all the ostitic bone is removed along with the cholesteatoma and if the cavity has a large communication with the external canal a recurrent cholesteatoma will not form.

Gundrum, Stambuk, and Gaines [22] (Los Angeles) reported the unusual case of a 3-month-old infant with a large swelling behind the left ear. A small lump had been present at birth but had been increasing in size. There was a tiny central perforation of the left drum. Aspiration of the mass produced only a little blood. An exploratory mastoidectomy revealed pure blood in the mastoid. Healing was uneventful.

Richardson [23] (Albuquerque, N. Mex.) has come to the conclusion that the antibiotics have not been of much help in the treatment of mastoiditis and is finding it necessary to perform a large number of acute mastoidectomies. "Though symptomatology has been minimized by antibiotics, it is doubtful whether the true pathology has been greatly altered or reversed." [This opinion is the reverse of the general consensus on the subject.]

EXTERNAL OTITIS

Senturia and Carruthers [24] (St. Louis) have published a preliminary report on the composition of ear wax, based on previous studies and work done in their laboratory. An artificial wax has been prepared and is being field-tested by the Navy. It is to be used in the dry, preinflammatory stage of ear-canal irritation. They suggest a mixture of 5 fatty acids, 13 amino acids, 7 metals, and numerous vitamins in a suitable base.

In a symposium at the American Academy of Ophthalmology and Otolaryngology, Senturia [25] (St. Louis) described the normal epithelium of the ear canal with its abundant epidermal glands. Chronic infections often gain a foothold because of inadequate protective secretions. Normal waxy secretions waterproof the surface and inhibit the growth of organisms. In biopsy specimens taken from patients with external otitis the glands may be filled with keratin plugs. When temperature and humidity are elevated, moisture will accumulate in the exfoliated skin. Slight trauma, such as scratching or water from swimming, is apt to start a growth of organisms already present. He advises full-thickness grafts for lining postoperative mastoid cavities and thinks donor sites such as the postauricular and axillary regions would be better, as these areas are better supplied with sebaceous glands.

Fisher [26] (Pasadena, Calif.) gave the pathologist's point of view in continuing the symposium on external otitis. He described a rapid method for identification of organisms and for the determination of their sensitivity to various antibiotics. He gives three tables of results in studying 378 cases of draining cavities following fenestration or mastoid operations. The commonest organism found was the Staphylococcus. The most potent antibiotic against all Gram-positive cocci was found to be erythromycin.

Neomycin was also very effective. The Gram-negative bacilli tend to be very resistant, and none of them were sensitive to penicillin, bacitracin, or erythromycin.

Fowler and Freeman [27] (New York), also in the symposium, spoke on therapy of external otitis and stressed the point that there was no one formula which would cure all otic infections. They agreed that careful cleansing was a very important first step in treatment. They did not hesitate to use irrigations of warm hypertonic saline solution, even in infected fenestration cavities. They are using polymyxin B or neomycin with boric acid powder and have been using them as a dusting powder postoperatively. Oxytetracycline powder has given "dramatic successes," especially in cases with Pseudomonas aeruginosa (Bacillus pyocyaneus) infections. They found an incidence of 22% and 27% sensitivity reactions to two sulfonamide preparations and advised that they never be used without rigid supervision.

Davidson [28] (Danville, Pa.), in summarizing for the symposium, agreed that careful mechanical cleansing of the canal was more important than local application of medications. After cleaning the canal he dries it with an air jet. He has the patient apply boric acid powder with a hand blower twice daily at home. He spoke of one case that had had a wet cavity for six years following fenestration. The cavity dried up in two weeks with boric acid powder and has remained dry. He prefers not to use any solutions. He believes the topical application of sulfa drugs should be discarded entirely.

Hara [29] (Los Angeles) reported the use of a new preparation, Acrisan,* in treatment of 100 cases of external otitis. Thirty-two patients were clear in one week and 29 were improved. This was considered to be much better than the various types of treatment he had used in the past.

Cultures showed Pseudomonas in 26% of cases, Staphylococcus albus 22%, Staphylococcus aureus 17%, Escherichia coli 8%, and Proteus 6%.

Baer and Litt [30] (New York) treated 10 cases of external otitis with an aqueous suspension of hydrocortisone and neomycin (Cortef suspension). Each of these patients had been treated unsuccessfully with a variety of therapeutic agents, usually by several physicians. Results were excellent in all cases. [This preparation and the similar ointment have been producing excellent results in my hands.]

Senturia and Alford [31] (St. Louis) reported the use of hydrocortisone acetate (Compound F) and neomycin in 90 patients with external otitis and various other ear infections. They used an ointment for the lesions of the external ear and an aqueous suspension for the patients with postmastoid and postfenestration infections. All types of these ear infections responded in a very "gratifying" manner, except a few cases which cultured fungi. "The most significant clinical observation is the consistent and excellent response obtained in that group of indolent and recalcitrant ears placed in the neurogenic category." Excellent results were also obtained in persistently draining mastoid and fenestration cavities. One severe perichondritis responded nicely.

Farrar [32] (London) treated 60 cases of infections of the external ear (34 were radical cavities and 26 otitis externa) with a solution of 10% polymyxin B sulfate in propylene glycol, acidified with acetic acid. In 20 cases of B. pyocyaneus 90% were dry in one week. Of the 20 cases caused by Bacterium coli 65% were cured, but only 10% were cured in the 20 cases caused by P. vulgaris. The patients applied the medication by filling the infected ear cavity twice daily, plugging the ear with cotton afterward.

McLaurin [33] (Baton Rouge, La.) summarized the general principles of treatment of external otitis. He found careful cleaning most important. In the acute stage where there is much pain and swelling he uses wicks of aluminum acetate solution (Burow's

* Acrisan contains aminoacridine caprylate (0.25%), pyrilamine maleate (1.0%), and benzyl alcohol (1.0%) in anhydrous propylethylene glycol.

solution). He uses para-(aminoethyl)-benzene sulfonamide hydrochloride (Sulfamylon) as the medication of choice where sensitization tests have not been done. Resistant cases are cultured and the medication used which is indicated by sensitization tests.

Sophian, Cooper, and Senturia [34] (St. Louis) reported the examination of serial sections of specimens of skin removed from the auditory canals of 40 patients with chronic otitis media. There was a plugging of the duct orifices, inflammation and necrosis of the apocrine glands, and other inflammatory changes. The apocrine glands seemed to suffer more damage than other structures.

Senturia, Cross, Lett, and Hardy [35] (St. Louis) reported on an extensive experiment promoted by the Air Force on external otitis. The study was done at Jacksonville, Fla., and included 381 patients with 493 infected ears. They were divided into six groups and treated by the following:

1. Oxytetracycline, otic
2. Polymyxin in saline
3. Sulfamylon, aqueous
4. Nitrofurazone (Furacin), otic
5. Oxytetracycline-polymyxin, otic
6. No antimicrobial therapy (isotonic saline drops and fatty acids in a wool fat [lanolin] base)

They concluded that none of the agents used could be considered uniformly satisfactory. In some cases the response was discouragingly slow. Oxytetracycline and oxytetracycline with polymyxin seemed to give slightly better results than other preparations. Cultures showed a high per cent of Pseudomonas. In 25% of "cured" cases Pseudomonas could still be cultured.

MENINGITIS

Blohmke and Link [36] (Frankfurt, Germany) have treated 40 cases of "most serious meningitis" of otogenic origin by opening the subarachnoid spaces through the mastoid cavity. Free drainage is obtained, intracranial pressure is reduced, and penicillin given by lumbar puncture is soon found in the draining cerebrospinal fluid. This was proved by adding a dye to the medication given intraspinally. Their mortality was 12.8%, as compared with other published figures of 20%-40%. [A neurological surgeon was asked about this procedure. He advised against it.]

McLay [37] (Edinburgh, Scotland) reported 30 cases of otogenic meningitis seen from 1938 until 1952. Diagnostic symptoms were listed as follows:

1. Uneasiness and anxiety of the patient for his future
2. Headache, which is usually frontal but may be deep and boring
3. Pyrexia which persists but does not fluctuate
4. Neck stiffness

In the 13 cases treated by the sulfonamides alone the recovery rate was only 38%, while the cases receiving penicillin and sulfonamides had a 74% recovery rate.

He advised early operation, as soon as adequate antibiotics had been started, in those cases with chronic otitis or with acute mastoiditis. In cases with acute otitis media only he did not perform mastoidectomy.

Most of the cultures of the cerebrospinal fluid were sterile (69%), probably because most of the patients had had large doses of antibiotics before spinal tap was done. Of those with positive cultures, 16% were streptococci and 9% were staphylococci.

Přecechtěl [38] (Prague, Czechoslovakia) reported four cases of recurring meningitis seen in the past 10 years. Three of the cases were otogenous and one followed fracture of a frontal sinus. One otogenous case had 13 separate attacks of meningitis following a fracture of the base of the skull. Two mastoid operations failed to prevent subsequent attacks.

In the discussion that followed, Meurman reported the case of a man of 47 who sustained a fracture of the base of the skull. There was no otitis at the time, but two years later he had an attack of meningitis. Mastoidectomy and "canalization of the subarachnoid spaces" was done. No infection was found in the mastoid. Two years later there was a second attack. Six months later there was another attack and a labyrinthectomy was done. He has now been well for seven months.

Cawthorne (London) then reported the case of a boy of 9 years who since the age of 4 had had 18 separate attacks of meningitis. He found a persistent petrosquamosal suture, exposed the middle fossa, and blocked off the suture by gelatin sponge. The boy had no more attacks after this.

LABYRINTHITIS

Bourgeois and associates [39] (France) reported the interesting case of a woman of 26 who developed a sequestration of most of the labyrinth of one ear after prolonged infection. There were so few symptoms pointing to the ear that she was treated for a long time with streptomycin for pulmonary tuberculosis, x-ray of the chest having shown some questionable shadows of the lungs. The streptomycin and other antibiotics had masked symptoms of the ear until finally facial paralysis and symptoms of intracranial pressure directed attention to the ear. There was also thrombosis of the lateral sinus and an extradural abscess. There had been no severe dizziness at any time. They quoted Ramadier, who had observed cases of complete destruction of the labyrinth without any vertigo.

SEROUS OTITIS

Rawlins [40] (San Francisco) added a new method of treatment for chronic secretory otitis media. After paracentesis is done he has the patient use self-inflation with a Politzer bag every few hours. Since the Politzer bag is rather large, he uses a firm 3 oz. rubber ear syringe. This treatment has shortened the course of the disease greatly. He also uses mass suction simultaneously with inflation following paracentesis.

Jones [41] (Boise, Idaho) advises aspiration and inflation for serous otitis. He is finding an increasing number of these cases. He urges adequate magnification in examining and treating them. He makes a small puncture in the drum and then does inflation of the tube with a catheter. If the fluid is thin, it may be removed by spot suction, using a small cannula inserted through the incision. If the fluid is thick, of the "glue ear" type, mass suction is applied to the canal and the tube is again inflated. If after three or four treatments the patient is not better, the patient is trained to inflate his own ears three or four times daily using a 3 oz. rubber ear syringe. He states that inadequately treated serous otitis is a potential cause of later adhesive deafness. He has not found that radiation helps serous otitis.

Armstrong [42] (Charlotte, N. C.) advised a new treatment for secretory otitis media. If conservative treatments fail, he makes the usual incision of the drum, clears out the fluid by suction and inflation, then inserts a small piece of plastic tubing through the incision and leaves it for several weeks, if necessary. He uses a special vinyl compound tubing 1.5 mm. in diameter and 1 cm. in length. Serum will then drain freely, air can enter the middle ear, and most cases are cured in two or three weeks. Five patients have been treated by this method, and the perforation has healed each time after removal of the tube. No infections have occurred. He warns that a permanent perforation might occur if the tube were left in too long. He instructs the patients to perform Valsalva inflation several times each day.

Theobald [43] (Chicago) reviewed the findings and results in 144 patients with secretory otitis media severe enough to require myringotomy. A much smaller number responded to conservative measures. These patients were seen over a period of six years.

> Etiology of the disease is blockage of the eustachian tube from infection, allergy, or mechanical factors. Once fluid has formed it becomes a factor causing blockage by causing persistent edema of the mucosa. . . . Allergy was rarely found to be a predisposing factor. Myringotomy is almost invariably required, and must be repeated as often as necessary.

A very interesting feature of his paper was his report of two cases of secretory otitis which later developed cholesteatoma. "These two cases lead one to speculate as to whether or not secretory otitis media may be the cause of many cases of so-called primary attic cholesteatoma." [This observation

agrees with Simpson's theory that cholesterol crystals may be present in simple effusions, especially if the blood cholesterol happens to be high. See the abstract of his article under Cholesteatoma.]

EOSINOPHILIC GRANULOMA

Dawes [44] (Newcastle- upon- Tyne, England) reported eight cases of eosinophilic granuloma primarily to illustrate the otological aspects. In several of the cases soft fluctuant swellings developed over the mastoids. Two excellent color photographs show the indolent yellowish granulations that appeared in postoperative mastoid wounds. Biopsy showed the eosinophilic infiltration that is diagnostic. X-rays showed the punched-out areas of the mastoid, skull, and other bones that are also diagnostic. The disease is usually seen in children but may appear in adults. Local lesions are much improved by x-ray treatment. The disease may be rapidly fatal or prolonged. Prognosis as to ultimate survival should be guarded.

Chisolm [45] (Baltimore) reported three cases of Hand-Schüller-Christian disease and commented on their otorhinologic aspects. One case had recurring polyps in one ear canal, with impairment of hearing in both ears. The patient was a girl 3½ years old. X-ray examination of suspected bones gave a typical appearance in all three cases. X-ray treatment and antibiotics produced rapid improvement. One case was not seen until lesions had progressed in both ears to permanent loss of hearing.

Eosinophilic granuloma, Letterer - Siwe disease, and Hand-Schüller-Christian disease are now referred to as variant types of systemic reticuloendotheliosis. Goodhill suggests "histiocytic granuloma" as a better, all-inclusive term.

The ultimate prognosis is uncertain: There may be late recurrences. He warns that the otologist must be suspicious of unusual lesions of the ears, especially in cases of sudden appearance of aural polyps, and ask for x-rays of the skull or other bones.

TECHNIQUE

Biber [46] (Gallipolis, Ohio) gave a method of treating central perforations using "therapeutic fillings" of camphenol, camphonaphthol, guaiacol, iodoform, and wool fat. Cotton pledgets are saturated with this ointment and placed against the perforation. This is repeated at intervals of several days until infection subsides. If the perforation has not healed he freshens the edges of the perforation with a silver nitrate stick or curet. Then blood taken from the patient's finger is dropped over the perforation and allowed to clot. After about two weeks the perforation is usually closed. [Dr. Ben Parks described a similar method of closing perforations of the drum years ago. He took blood from the patient's vein and put a small amount into the canal.]

FOREIGN BODY IN MASTOID

Cross and Brower [47] (Baltimore) reported the case of a 69-year-old man who had had a mastoid operation 30 years before. The ear had drained continuously. Operation revealed an old piece of cotton 1 cm. in diameter that had apparently been left in the mastoid antrum at the operation 30 years before. Symptoms of dizziness, tinnitus, headaches, cervical pain, and persistent drainage cleared up promptly.

UNEXPLAINED NECROTIC AREAS

Nager and Nager [48] (Switzerland) report two cases of multiple areas of necrosis in routine study of temporal bones at Johns Hopkins Hospital. These cases resembled the lesions seen in syphilis, but there were no other lesions to confirm the diagnosis and there had been no symptoms of syphilis. They suspect that these cases may indicate a hitherto unknown disease which has much in common with late congenital syphilis.

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Books

Bronchography. By Dr. E. Stutz and Dr. Heinz Vieten. Cloth, $15.70. Pp. 250, with 234 illustrations. Georg Thieme Verlag, Herdweg 63, Stuttgart, 1955.

The authors present an extremely comprehensive discussion of bronchography. The first chapter deals with (*a*) the contrast material; (*b*) types of anesthesia to be used with their chemical, pharmacological, and toxicological relationships; (*c*) methods of administration of the contrast material; (*d*) the technique of bronchography with all of its problems. The second section deals with normal and pathologic physiology, and the final section deals with morphologic changes in the bronchial system. There are detailed descriptive findings illustrated by both bronchograms and line drawings of the bronchial pathology as seen in bronchitis, pneumonia, bronchiectasis, lung abscess, tuberculosis, blastomas, silicosis, foreign bodies, anomalies, postoperative changes, traumatic rupture, and other conditions. There are numerous bronchograms with detailed descriptions and legends which in certain areas are further clarified by line drawings. In addition, there is an extensive bibliography with 1654 references. This is an excellent book and extremely valuable to the bronchoscopist and the chest surgeon.

Infection tubo-tympanique et surdités labyrinthiques. By René Mayeux and Henri Martin. Price, 200 francs. Pp. 158, with 169 illustrations. Masson & Cie, 120 Saint-Germain Blvd., Paris, 6e, 1954.

The mucosa of the upper respiratory tract more than any other tissue is exposed to various infections coming from outside the body. The tympanic cavity, with the round and oval windows on its medial side, is a source of vulnerability to the inner ear. As the tympanic cavity is opened to all infections coming from the pharynx, one can see the importance of the very frequent lesions of the tympanic cavity in the pathology of the labyrinth. Moreover, the lesions of the middle ear may facilitate the fixation on the labyrinth of toxins or bacteria in circulation in the blood.

The authors have anteriorly shown that a unilateral lesion of the middle ear may in certain cases lower the bone conduction in the other ear and the air conduction for high-pitch sounds. In their book, the authors study the three ways by which the infections can reach the middle ear.

At first they study these lesions with clinical observations and audiograms; then they prove them experimentally with the help of new or incompletely experimented methods in man, such as tympanic inflation, injections of hypertonic serum or distilled water, and injections of cocaine in the tympanic cavity. Experiments on animals proved part of these facts. Therapeutic indications are precise.

Directory of Otolaryngological Societies *

FOREIGN AND INTERNATIONAL

Canadian Otolaryngological Society
(Société Canadienne d'Otolaryngologie)

President: Dr. D. S. Gorrell, 110 Medical Arts Building, Calgary, Alta.
Secretary: Dr. G. Arnold Henry, 328 Medical Arts Building, Toronto.
Place: Chateau Frontenac, Quebec, Canada. Time: June 6-7, 1956.

International Bronchoesophagological Society

President: Dr. Antonio da Costa Quinta, Lisbon, Portugal.
Secretary: Dr. Chevalier L. Jackson, 3401 N. Broad St., Philadelphia 40.
Meeting: Fourth International Congress of Bronchoesophagology.
Place: Buenos Aires, Argentina. Time: Oct. 28-29, 1955.
President of Congress: Dr. Antonio Carrascosa.

International Congress of Audiology

Place: Leyden, Netherlands.
General Secretary: Dr. H. C. Huizing, 182 Oostersingel, Groningen, Holland.

International Course in Paedo-Audiology

Place: Groningen, Netherlands.
General secretary: Dr. H. C. Huizing, 182 Oostersingel, Groningen, Holland.

Pan-American Association of Oto-Rhino-Laryngology and Broncho-Esophagology

President: Dr. Juan Manuel Tato, Azcuenaga 235, Buenos Aires, Argentina.
Secretary: Dr. Chevalier L. Jackson, 3401 N. Broad St., Philadelphia 40.
Meeting: Fifth Pan-American Congress of Oto-Rhino-Laryngology and Broncho-Esophagology.
Place: San Juan, Puerto Rico. Time: April 8-12, 1956.
President of Congress: Dr. Juan H. Font, Medical Arts Building, San Juan.

Sixth International Congress of Otolaryngology.

President: Dr. Arthur W. Proetz, 3720 Washington Blvd., St. Louis.
General Secretary: Dr. Paul H. Holinger, 700 N. Michigan Ave., Chicago 11.
Place: Hotel Statler, Washington, D. C. Time: May 5-10, 1957.

NATIONAL

American Medical Association, Scientific Assembly, Section on Laryngology, Otology and Rhinology

Chairman: Dr. John R. Lindsay, Chicago.
Secretary: Dr. Hugh A. Kuhn, 112 Rimbach St., Hammond, Ind.

American Academy of Ophthalmology and Otolaryngology

President: Dr. Algernon B. Reese, 73 E. 71st St., New York 21.
Executive Secretary-Treasurer: Dr. William L. Benedict, 100-1st Ave., Bldg., Rochester, Minn.
Place: Palmer House, Chicago. Time: Oct. 9-15, 1955.

* Secretaries of societies are requested to furnish the information necessary to keep this list up to date.

AMERICAN BOARD OF OTOLARYNGOLOGY

President: Dr. Frederick T. Hill, Professional Building, Waterville, Maine.
Secretary-Treasurer: Dr. Dean M. Lierle, University Hospitals, Iowa City.
Place: Sheraton-Mount Royal Hotel, Montreal, Canada. Time: May 6-11, 1956.

AMERICAN BRONCHO-ESOPHAGOLOGICAL ASSOCIATION

President: Dr. Daniel S. Cunning, 115 E. 65th St., New York 21.
Secretary: Dr. F. Johnson Putney, 1719 Rittenhouse Sq., Philadelphia 3.
Place: Sheraton-Mount Royal Hotel, Montreal, Canada. Time: May 15-16, 1956 (afternoons only).

AMERICAN LARYNGOLOGICAL ASSOCIATION

President: Dr. Bernard J. McMahon, 8230 Forsyth Blvd., Clayton 24, Mo.
Secretary: Dr. Harry P. Schenck, 326 S. 19th St., Philadelphia 3.
Place: Seigniory Club, Montreal, Canada. Time: May 13-14, 1956.

AMERICAN LARYNGOLOGICAL, RHINOLOGICAL AND OTOLOGICAL SOCIETY, INC.

President: Dr. Dean M. Lierle, Iowa City.
Secretary: Dr. C. Stewart Nash, 708 Medical Arts Bldg., Rochester 7, N. Y.
Place: Sheraton-Mount Royal Hotel, Montreal, Canada. Time: May 15-17, 1956 (mornings only).

SECTIONS:

Eastern.—Chairman: Dr. John A. Murtagh, Hanover, N. H.
Place: The Statler Hotel, Boston. Time: Jan. 13, 1956.

Southern.—Chairman: Dr. J. M. Robison, Houston, Texas.
Place: The Shamrock, Houston, Texas. Time: Jan. 27-28, 1956.

Middle.—Chairman: Dr. William H. Craddock, Cincinnati.
Place: The Netherlands Plaza, Cincinnati. Time: Jan. 16, 1956.

Western.—Chairman: Dr. David D. De Weese, Portland, Ore.
Place: County Medical Society Building, San Francisco. Time: Jan. 21, 1956.

AMERICAN OTOLOGICAL SOCIETY, INC.

President: Dr. William J. McNally, 1509 Sherbrooke St. West, Montreal 25, Canada.
Secretary-Treasurer: Dr. Lawrence R. Boies, 90 S. Ninth St., Minneapolis 2.
Place: Seigniory Club, Montreal, Canada. Time: May 11-12, 1956.

AMERICAN OTORHINOLOGIC SOCIETY FOR THE ADVANCEMENT OF PLASTIC AND RECONSTRUCTIVE SURGERY, INC.

President: Dr. Joseph Gilbert.
Secretary: Dr. Louis Joel Feit, 66 Park Ave., New York 16.

AMERICAN SOCIETY OF OPHTHALMOLOGIC AND OTOLARYNGOLOGIC ALLERGY

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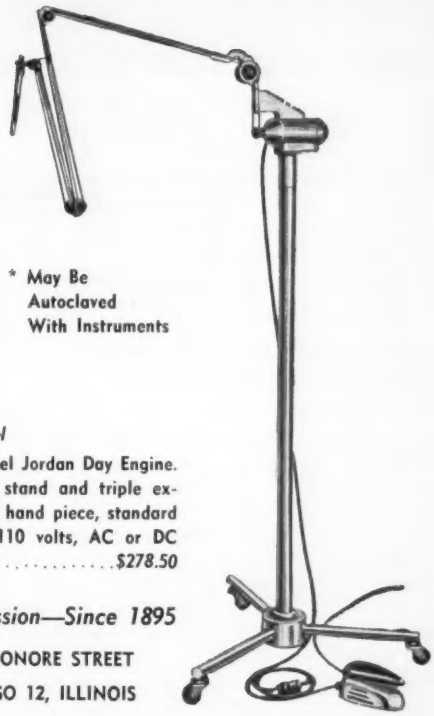

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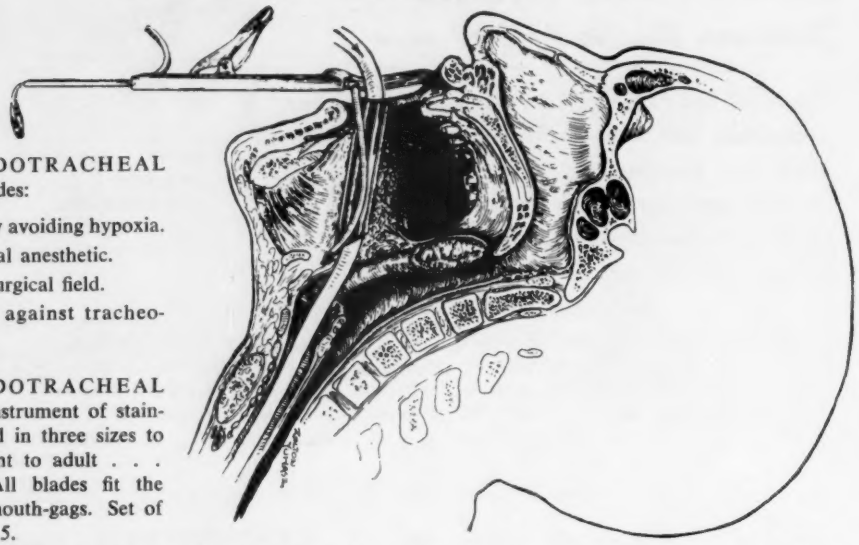

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*Barton, R. T.: Instrument for endotracheal anesthesia during oro-pharyngeal surgery. J. A. M. A. 153:1017 (Nov. 14) 1953.

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And what a lift the "Specialist" gives your office, with its clean, modern lines and superlative workmanship. A wide selection of paint and upholstery colors makes it easy to match existing office decoration; allows you more leeway when you redecorate. The accent is on fine furniture design, on playing down that cold equipment look. It's good taste to own a "Specialist".

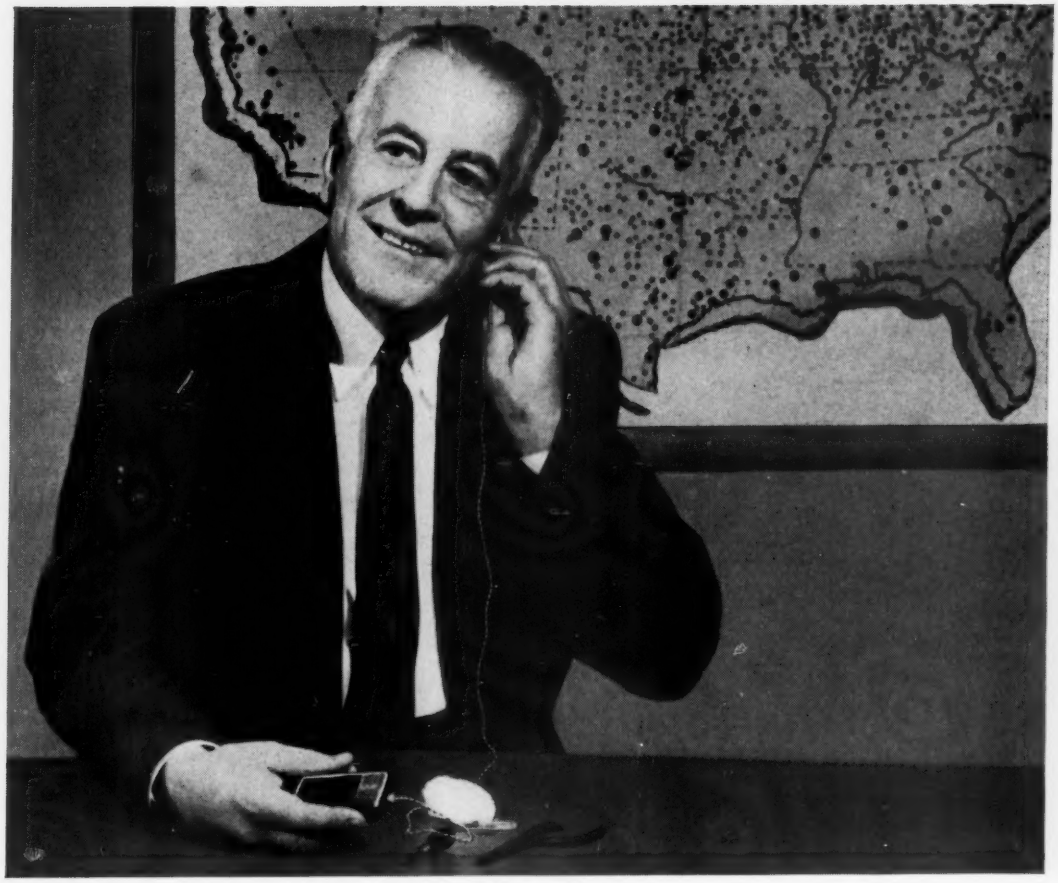
For complete information on the "Specialist" and its companion RELIANCE #400 stool, contact your regular supply dealer.

F. & F. FK

Manufacturers since 1898

KOENIGKRAMER CO.

Western Ave. at Naeher St. Cincinnati 14, Ohio



If your patient is HARD-OF-HEARING he needs three things...

1. ***A hearing aid*** **suited to his particular type of deafness. SONOTONE has many models—one of them will *help him to hear better.***

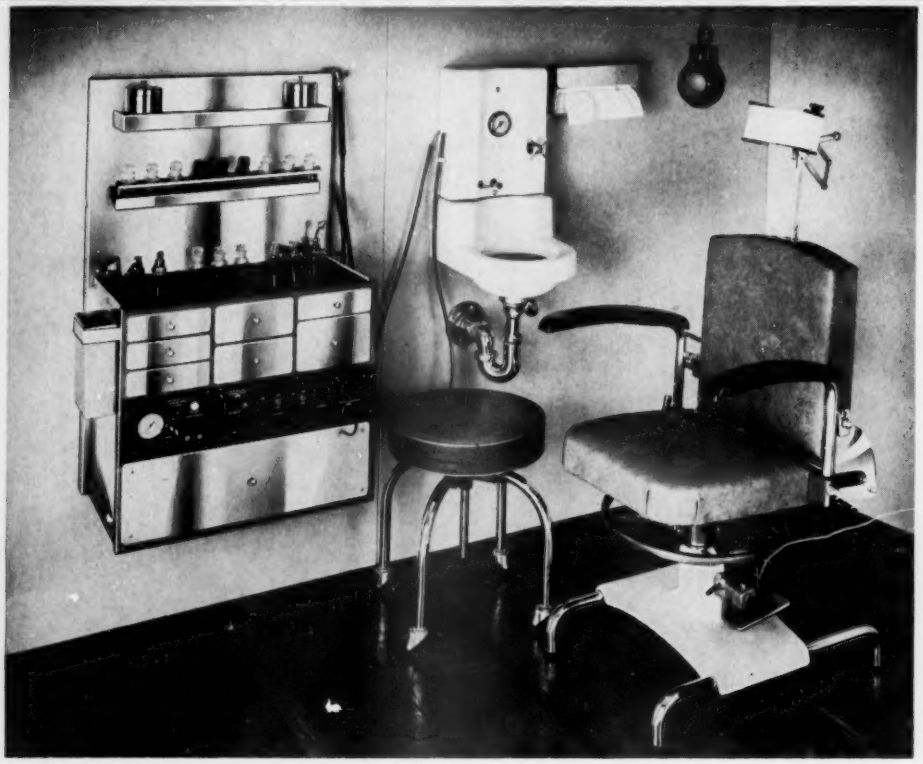
2. ***Friendly guidance*** **in choosing his aid and in teaching him to use it. SONOTONE Consultants have the training and the experience to help him.**

3. ***Uninterrupted hearing.*** **If his hearing aid doesn't work—whatever the reason—the consequences may be serious. No matter where he purchased his SONOTONE, he received with it a guarantee of uninterrupted hearing—renewable annually at a reasonable fee. Any SONOTONE office will honor this guarantee, including on-the-spot adjustments and repairs. *He walks out hearing.***

If your patient has a hearing aid problem suggest he see SONOTONE first. SONOTONE has over 400 of its own offices in the United States. One of them is reasonably near you. Consult the telephone directory for the address or write Dept. A-105, Sonotone Corporation, Elmsford, N. Y.

SONOTONE®

A Lifetime Program for Better Hearing



A COMPLETE TREATMENT ROOM IN A SMALL AREA

The dimensions in the above photograph are 5' 9" along one wall and 4' 2" along the other. In this area, conveniently arranged, is everything needed to make a complete examination. However, it need not be confined to this limited space. The complete absence of piping and wiring is especially noticeable. A number of other arrangements will be furnished on request.

Treatment Stand: Covered with stainless steel. Contains: air regulator with gauge, tubing, cutoff and air filter; nasopharyngoscope rheostat; push button: cautery transformer and rheostat; transilluminator complete with rheostat, cord, handle, lamps, antrum and frontal tips; seven metal drawers on fiber runners and one large drawer for towels; waste container; bakelite covered work table; space for six spray bottles, twelve solution bottles, shelf for cotton jars; pocket for history card or prescription blanks; and a spray bottle heater; the whole presents an attractive appearance and will not tarnish and is easy to keep clean. Price complete without glassware $185.00. Without air but with electrical equipment $155.00. With air equipment only $140.00. Without either air or electrical equipment $110.00. Glassware available.

Chair: Can be placed in horizontal position, will not tip in this position; raised and lowered by large hand wheel; paper covered headrest removable; locked with foot-pedal; bakelite armrests removable. Back locks rigidly in any position. As shown in brown. $140.00.

Turning Chair: By adding a footrest and the necessary handles this chair can be used for turning tests. All the additional equipment is easily and quickly removable. Add. $30.00.

Combined Suction and Cuspidor: This is an entirely new piece of equipment. It was designed to eliminate the cost of installing a separate suction. The apparatus is 12" wide and projects 13¼" from the wall. The flushing rim and the suction is furnished with a vacuum breaker and should meet all plumbing requirements. Stop and trap not furnished. Available in ivory, green and white. Price $85.00.

Ceiling Light: A telescopic light attached to the ceiling. May also be attached to base board in back of chair. Available in 4, 5, 6 and 7 ft. (extended). 4 ft. $15.50 (add one dollar per ft.).

Light Shield: Takes an ordinary 100 watt lamp. Will not burst; spot can easily be rotated. $5.00.

Stool: A soft upholstered stool with easy running ball bearing stem casters. $20.00. Stool with back, $26.00.

Catalog sent upon request.

All Prices are F.O.B. Los Angeles, Calif.

Surgical Mechanical Research, Inc.

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